"The Comparative Value of Labor in Different Countries."*

BY CHARLES ORMSBY BURGE, M. INST. C. E.

The following notes as regards manual work done, are chiefly the result of the author's experience, as acting for direct employers of labor in various countries abroad and at home, including work by Englishmen, Frenchmen, Belgians, Italians, Greeks, Spaniards, Hottentots, Kaffirs, Zulus, Madrassees, Moplahs, Candaharees, and other tribes, varying as much in their daily rates of wages as from 3*d.* up to 10*s.* for the same character of work.

The late Mr. Brassey is said to have stated that, when native labor is fairly plentiful, difference of wages does not materially affect price of work, and no doubt, if the absence of labor-saving appliances, and the greater cost of transport and European superintendence, be set against the lower wages, the total cost of a large work abroad may not be greatly different from that of a similar one at home; but if he meant that wages generally adjust themselves to the ability of the workman, the statement is certainly open to question.

It is from the latter point of view that the subject is dealt with in this paper, that class of work in which manual labor is the chief ingredient being alone considered in the comparison, and the result arrived at is, in general this, that the lower the wage is, the lower is the price of work; though of course, not in the same proportion.

To illustrate this, a few tables are subjoined, showing roughly the comparison between the physical capabilities of various races for different classes of work, and that between the actual cost of the results produced. In every case the latter is obtained by dividing the sum paid direct to the pieceworker, by the number of units of work executed for it, and an average is taken from large totals:

TABLE NO. I.—EARTHWORK.

Side Cutting excavated and removed to Embankment. Nature of Soil, Lift, and Lead being approximately the same in each case.

	Amount of Work done in a given time, average English Quantity being Unity.	Cost of Unit of Work, (Labor only), English average being Unity.
Englishmen	1.00	1.00
Frenchmen, Belgians, Germans, North Italians, &c.	0.75 to 0.90	0.90 to 1.00
Southern Europeans	0.60 " 0.85	0.60 " 0.80
Hottentot half-breeds	0.50 " 0.80	0.90 " 1.25
Kaffirs, Fingoes, and Zulus	0.40 " 0.70	0.80 " 1.00
The stronger Indian races	0.40 " 0.70	0.25 " 0.60
Inferior " "	0.25 " 0.40	0.20 " 0.50

TABLE II.—ORDINARY BRICKLAYING.

	Amount of Work done in a given time, average English Quantity being Unity.	Cost of Unit of Work (skilled Labor only.) English average being Unity.
Englishmen	1.00	1.00
Frenchmen, Germans, Dutchmen, &c.	0.80 to 1.00	0.80 to 1.00
Natives of India, best class	0.40 " 0.50	0.50 " 0.65
" " inferior	0.30 " 0.40	0.43 " 0.60

TABLE III.—HAMMER-SQUARED RUBBLE. DRESSING AND SETTING ONLY.

	Amount of Work done in a given time, average English Quantity being Unity.	Cost of Unit of Work (skilled Labor only), English average being Unity.
Englishmen	1.00	1.00
Frenchmen, Germans, &c.	0.75 to 0.90	0.90 to 1.00
Southern Europeans	0.55 " 0.70	0.70 " 0.80
Natives of India, best class	0.40 " 0.60	0.65 " 0.80
" " inferior	0.33 " 0.50	0.60 " 0.80

TABLE III.—PAINTING ON NEW WORK.

	Amount of Work done in a given time, average English Quantity being Unity.	Cost of Unit of Work (skilled Labor only), English average being Unity.
Englishmen	1.00	1.00
Natives of India	0.40 to 0.60	0.60 to 0.80

The skilled work, generally speaking, of the Englishman, it must be admitted, is superior to that of the foreigner.

Now the chief characteristic of these Tables is the difference in cost of result of unskilled labor in England and in India, and it is clearly shown that, to explain it, other causes must be brought than those produced by the ordinary supply and demand theory, which, if fully operating, would absolutely equalize the amounts paid for the same work everywhere.

Economists state that rates of wages for unskilled labor may be divided into two categories, namely, first the *market* rate, which is that which chiefly prevails in the more wealthy communities, and is mainly influenced by the laws of supply and demand; and secondly, the *natural* rate, where these laws find their limit, and which represents—having regard to the prices of commodities—the lowest means of sustenance for the workman and his family. It is obvious that no supply of labor, however great, can bring wages below this point; as should they be lower, the laborer must starve, and the work must come to an end. Now from various causes, which cannot be entered upon here, the natives of India and many other populous tropical countries, are to a great extent living on *natural* wages; and this explains partly the advantage which the Indian employer possesses over the English one, as shown by the Tables, in the cases considered.

Then there is in India the disinclination of the native to leave his village, and follow the demand for labor, and the absence of any ambition on his part to be any richer than his forefathers or neighbors; moreover, his domestic requirements are so few that the women are as numerously employed as the men, and this again tends to cheapen prices, the women being direct producers of work, while in Europe they are entirely occupied in providing for the necessities and comforts of their husbands or brothers, two people having to be fed for the work of one.

Again, the wages of the Indian native are nearly all returned to his employer in work done. They are mainly spent on food which, if not of a very strength-giving character, is cheap, and consists almost wholly of tissue, forming matter, all utilized in the work given in exchange for it, small as that work relatively is. Turning to the Englishman, beer, no doubt, supplies strength; but most people would admit that the three or four quarts drunk daily by the average British navvy, is more than is necessary for the work he has to perform. The tropical native commonly spends much of his spare time in sleep, thus storing up tissue to be expended for the benefit of his employer, and saving his money the while; [1] the white man, on the contrary, probably using the same opportunity for spending his substance in more exciting distractions, legitimate or otherwise, to provide for which the general rate of wages is kept up, and the equivalent return for it, in work, kept down.

The extreme case of European as compared with Indian unskilled labor, has been chiefly dwelt upon as showing, in a more emphatic way, the causes of divergences such as are shown in the Tables; but those of intermediate races, and of the artisans work might be similarly explained.

Another reason for divergence, which can hardly be left out of sight, is the method of working in different countries. As regards earthwork for instance, there are in England and other places, the "getter" excavating earth with a pick, the "filler" transferring it with a shovel to the barrow, which the "wheeler" drives to its destination on a wheeling-plank. In Spain, a donkey with a *seron* or pannier, and a boy to drive it, replaces the barrow and wheeler. In India the filler uses a tool something like a large hoe, with a short handle, called a *momati* or *phoura*, by which he fills the basket placed on the ground between his feet; he then assists a woman cooly to place it on her head, and it is carried in that fashion to the bank.[2]

Whether the mechanical advantage in the locomotive part of these operations lies in conveying the work through the arms to the spine as in the English method, or using the spine only, as in the Indian fashion, or throwing it entirely on to the donkey as in Spain, is a moot point. Comparing the use of the basket in India as against the barrow in England: a cooly woman at 3d. per day, will take sixty journeys to deposit a cubic yard of ordinary light clay, while an English navvy, at sixteen times the wages, will have to make 160 journeys with a barrow holding $\frac{1}{3}$ cubic yard, in the same time, to give the same value in work for the money paid to him for that time. In other words, allowing 1½ mile per hour for the average walking speed of the woman, the navvy would have to drive his barrow at four miles per hour to compete with her.

The case of prices in sparsely peopled new countries, would occupy a wider field of inquiry than is advisable to undertake in the present Paper, involving questions of the enhanced rates due to imported labor and other considerations. Enough has been said to lead to the conclusion that every engineer in estimating, or contractor in tendering, for work abroad, unless guided by existing rates, should exercise great care in ascertaining the habits and character, as well as the rates of wages, of the people by whom any proposed works are to be constructed.

*From the Proceedings of the Institution of Civil Engineers.

[1] It is not unusual for the cooly to stop work before the end of the week, if he has earned enough to barely sustain life till the beginning of the following one, spending the interval in almost total inactivity and in sleep.

[2] See the Paper "Earthwork in Scinde," by W. H. Price, M. Inst. C. E., in "Professional Papers on Indian Engineering," January, 1874, for comparative cost of barrow and basket work.

Bleaching Printed Paper.

Printed paper, such as books, engravings, maps, etc., may, when stained or discolored, be whitened by (1) wetting them with pure clean water, (2) plunging into a dilute solution of chloride of lime, (3) passing them through water soured with hydrochloric acid, and then, (4) through pure water until every trace of acid be removed. This process may again be improved by further dipping them into a weak solution of some antichlor, and again washing them before finally drying them. It is only rare and valuable original works or specimens of art that are worth this treatment, which, owing to the very nature of paper, requires considerable address to manage. In many cases a sufficient degree of renovation may be effected by simply exposing the articles, previously slightly moistened, to the fumes of burning sulphur, followed by passing them through a vessel of pure water.

CABLE RAILWAY. A San Franciscan has invented a cable car for street railways that dispenses with the grip, does not wear the cable, and secures the same results as the old method with but one-third the propelling power. His plan consists of a succession of large and small wheels inside the car, over which the cable passes.

THE MAXIM MACHINE GUN.

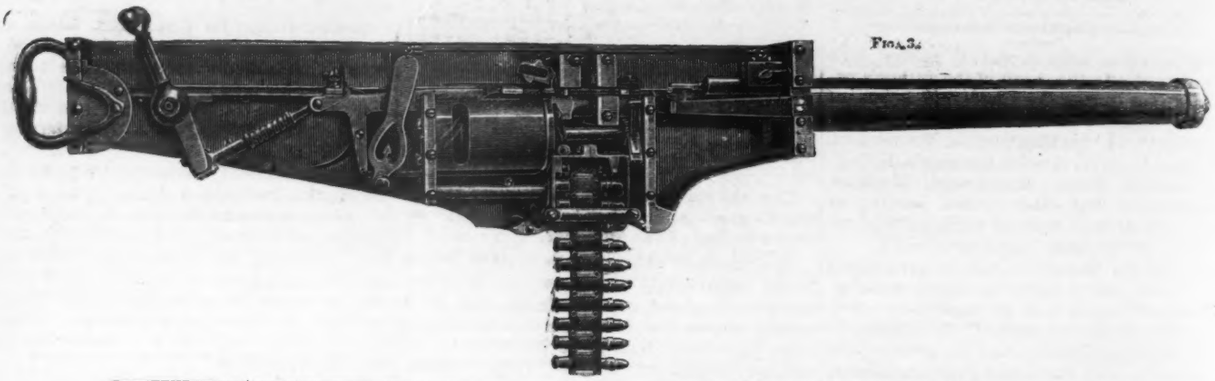


FIG. 3.

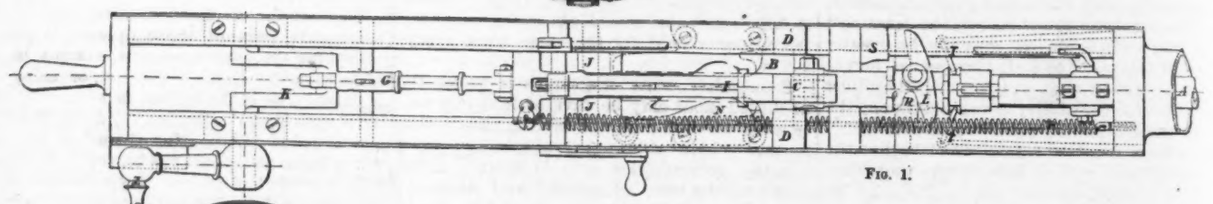


FIG. 1.

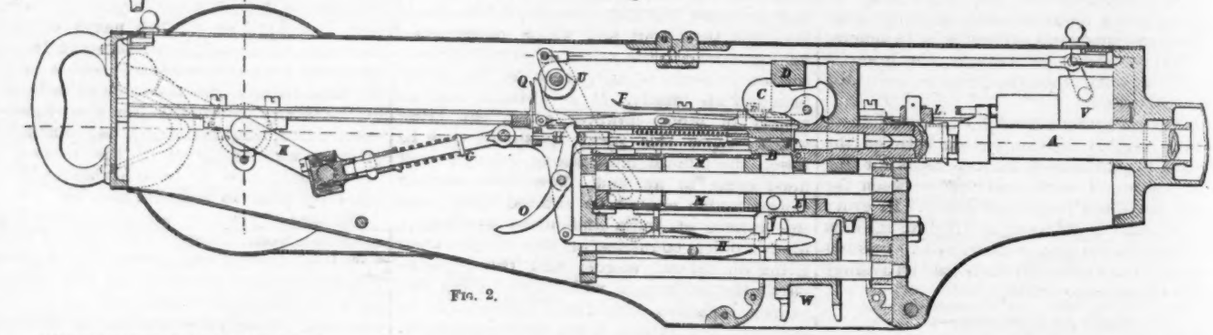


FIG. 2.

THE MAXIM MACHINE GUN.

Description of the Maxim Automatic Machine Gun.*

BY MR. HIRAM S. MAXIM, OF LONDON.

Previous Machine Guns—The first practical machine gun is believed by the writer to be that made by Dr. Gatling, an American inventor, by whom it was presented to the United States Government about 1863. In its earliest form it was not made for firing metallic cartridges, and was constructed with a series of steel sections, which, after having been previously loaded by hand, were one after another brought up to the breech of the barrel and pressed firmly against it at the instant of firing. None of the Gatling guns however appear to have been actually used in the field before the close of the American war in 1865. The next machine gun of any note was that of Hotchkiss, another American inventor, who took it to France, where he established a large factory, and has supplied his guns to nearly all the principal governments in the world. This gun was followed by the Nordenfelt and the Gardner.

All four of these machine guns depend upon hand power for performing the various operations of loading, firing, and extracting the empty shells. Three of them are worked by a crank, while the Nordenfelt gun is worked by means of a lever, like an ordinary pump. As considerable force is required for working either the crank or the lever, the gun has to be mounted on a very firm stand or base, in order that it may not be rendered unsteady by the motion given to the handle. This necessity precludes the possibility of turning these guns with any degree of freedom; excepting the Hotchkiss gun, which is essentially a slow-firing gun, firing only about forty shots per minute, and is the only one that can be moved freely while firing.

These guns are each provided with a magazine of ammunition. The Hotchkiss magazine holds about a dozen cartridges; and the quick-firing Gatling, the Nordenfelt, and the Gardner, have each a magazine holding about a hundred. The magazine is placed on the top of the gun, and with any great rapidity of firing has of course to be replenished very often; for which purpose two men, at least, are required, who are compelled to expose themselves above the gun, both the magazine and the men thus presenting a target to the enemy's fire.

The workmanship of all four of these guns is exquisite. Their weak point does not lie here, but arises from another cause which would be very difficult to remedy in them. It is said by some military men that no machine gun has ever been brought into action which has not become "jammed" at the critical moment. Even if that be not strictly true, still the liability to accident from this cause is very great. A certain percentage of all cartridges fail to explode promptly at the instant of being struck: to use the technical expression, they "hang fire." Suppose that, while the handle of the gun is being worked at its highest speed, one of these sluggish cartridges happens to enter the barrel. It is struck; and instantly, before it explodes, the breech is opened, and the cartridge begins to be withdrawn again out of the barrel. At this instant the explosion takes place, breaks the shell in two, drives the front half forwards into the barrel, and blows the rear half out of the breech, and sometimes blows up the magazine. At any rate, it always drives the forward end of the cartridge firmly into the chamber of the barrel; and if the magazine does not explode, the next rotation of the crank drives a loaded cartridge into this chamber; the gun then becomes blocked or jammed, and is of no further use.

Maxim Automatic Gun.—It is many years since the writer conceived the idea of making a gun in which the recoil should be utilized for loading and firing; but it was not until 1883 that he had any time to devote to this problem. Before commencing experiments he considered carefully the different methods which might be employed for working an automatic gun by means of power derived from the burning powder. In those which he afterwards experimented upon, the power required was derived in the six following ways: (1) Power derived from the gases escaping from the muzzle of the gun, either by utilizing their pressure directly, or by employing them as an ejector to produce a vacuum in a chamber near the muzzle of the gun; (2) power derived from the recoil of the entire gun; (3) power derived from the recoil of the barrel, the breech-block, and the lock; (4) power derived from a backward motion of the cartridge in the chamber at the instant of exploding; (5) power derived from only a portion of the cartridge moving backwards; (6) power derived from the elongation of the cartridge at the instant of exploding.

Experimental Apparatus.—The apparatus is now exhibited that was used for conducting experiments on a gun in which the power was derived according to the third of the above methods—namely, from the recoil of the barrel, the breech-block, and the lock. As the writer was the first to make a gun of this kind, he had no data whatever to go upon, and had therefore to contrive some kind of device for ascertaining both the quantity and the character of the power to be dealt with. This apparatus consists of two parallel steel bars, clamped into supports, and having the barrel and the breech-block mounted between them. The whole is so constructed that all of the parts are adjustable. The distance through which the barrel recoils before the breech-block becomes detached from it, is adjustable; the further distance that the barrel travels backwards, after it becomes detached from the block, is also adjustable; the travel given to the striker is adjustable; the angle at which the crank stands at the instant of explosion is adjustable; the amount of weight in the rotating parts and their distance from the center of rotation are also adjustable.

This experimental apparatus was made as far as possible of soft steel and brass, in order that the action of the gunpowder might be observed upon the various parts. If any part showed signs of yielding under the strain, it was obvious that this part required strengthening in the gun ultimately to be made. The apparatus has already fired about a thousand cartridges, and at the present time is still in condition to be fired. With one hand on the muzzle the barrel can be pushed back with sufficient force to perform the whole cycle of operations for firing, the push of the hand taking the place of the recoil of the barrel. In this way it has been found that a pressure of about 60 lb. travelling through a distance of ⅞ inch is the power required for working the gun, which is very much less than the actual power derived from the recoil, as determined approximately by the writer in experiments with a Winchester rifle of the "express" pattern.

First Gun.—Having in this way determined the character and quantity of the power to be dealt with, and having ascertained the time required for the gas to escape from the barrel, as well as the strength required for the several parts, and the distance through which they had to travel, the writer proceeded to make his first gun, the construction of which is shown in the accompanying engravings.

The barrel A, Figs. 1 and 2, is encased throughout the greater portion of its length within a water-jacket, which projects from the front end of the casing that incloses the machinery. Its backward motion, produced by the recoil of a shot just fired, is, at first, opposed by a pair of flat springs, one at each side, which have to be forced apart by toggle struts T T recessed into the sides of the barrel, as shown in the plan Fig. 1, and in Figs. 9 to 11. As soon as these struts have passed the center, the springs close together again, and thereby aid the further backward travel of the barrel. During the first half of the ⅞ inch backward travel of the barrel it carries the breech-block B with it at the

* Paper read before the Institution of Mechanical Engineers.

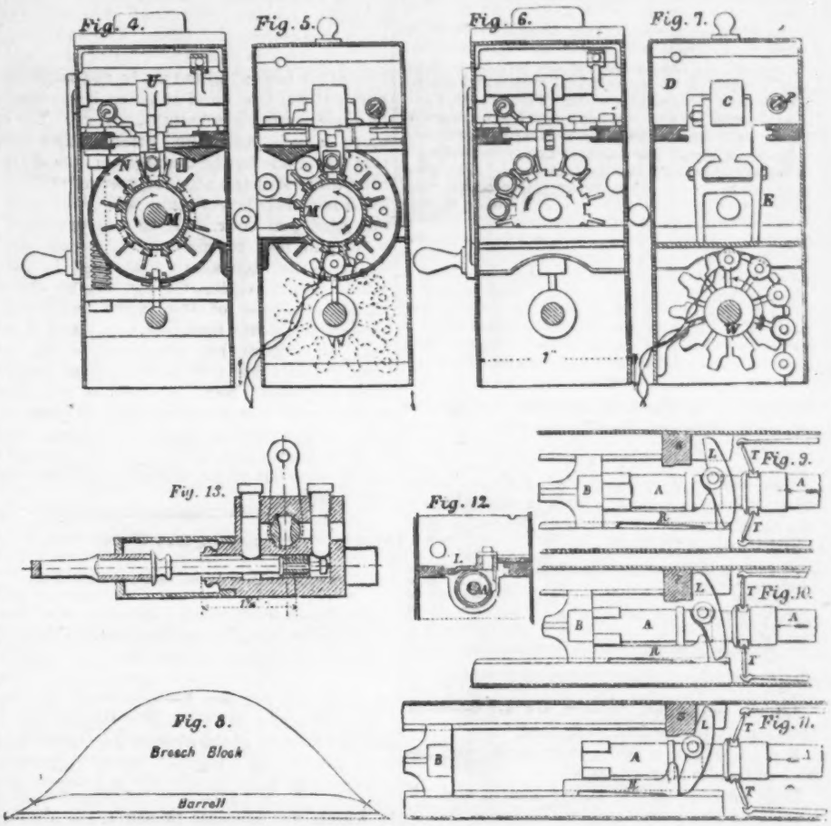
same speed, the two being secured fast together by the locking catch C, Fig. 2, which is held firmly down under the crossbar D. But when the barrel has moved backwards through $\frac{1}{8}$ inches, the catch is free from under the crossbar, and is lifted by a projection on its front end coming in contact with the face of the crossbar, thereby releasing the breech-block from the barrel. At the same instant a straight lever L centered upon the barrel (Figs. 1, 9, 10, and 11) encounters with one of its arms a stop S fixed in the casing, while its other arm bears against the toe of a sliding rod R, the rear end of which bears against the breech-block. Both the stop S and the toe of the rod R are made with long bearing faces slightly curved, as shown in Figs. 9 to 11, and as the slightly curved arms of the lever L roll over them, the respective leverages change very rapidly in relation to each other, and become inverted, with the result of imparting a rapidly accelerated motion to the breech-block. Consequently while the barrel travels through the remaining $\frac{1}{8}$ inch of its backward motion, the breech-block is driven backwards with sufficient force to carry the crank K over the back center (Figs. 1 and 2); the radius of the crank is 3 inches, and the connecting-rod G, from the breech-block, is 6 inches long. The action of the lever L in accelerating the breech-block has also the converse effect of simultaneously retarding the backward travel of the barrel; and all the backward motions cease at the instant of the crank passing the back center. With freshly loaded cartridges the momentum given to the crank and its attachments is found sufficient to drive the breech-block forward again into its firing position and to fire the next shot. But with old and weaker cartridges the gun is found to work with greater certainty if a strong helical spring P is used (Fig. 1) to assist in drawing the breech-block forwards again into its firing position after the crank has passed the back center. Consequently all guns made after the very first experimental guns are now provided with this spring

Immediately upon the breech-block quitting the barrel, the tail of the extractor E (Fig. 2), which is a forked lever centered upon the barrel, comes against a stop fixed in its path; and the forked end of the lever which takes hold of the cartridge rim or flange at each side, withdraws the empty cartridge shell about ¼ inch out of the barrel. Its extraction is then completed by a hook I attached to the same crosshead as the breech-block. The hook runs underneath a pair of long fixed springs F, by which it is pressed down upon the cartridge so as to keep a secure hold while extracting it; but at each end the springs are curved slightly upwards, in order to reduce the pressure upon the hook in its foremost position, where it has to lift for catching hold of the cartridge flange, as well as in its hindmost position, where it has to be lifted again by the fixed crosbar J (Fig 1) for releasing its hold of the cartridge. In this way the empty cartridge is drawn back into one of the grooves or pockets in the rim of the magazine or feeding cylinder M, which is mounted upon an axis immediately beneath and parallel with the line of travel of the breech-block.

The magazine M (Figs. 4 to 7) is rotated intermittently by an arrangement of spiral ratchet-wheel and pawl, which is somewhat similar to the arrangement commonly employed in rock-drills for rotating the drill automatically between each blow: the motion of the breech-lock in the last part of its backward travel, when the empty cartridge is entirely drawn out of the barrel, rotates the cylinder M through half the pitch or distance to the next groove or pocket, which has already been charged with a fresh cartridge; and the first part of the forward travel rotates it of the barrel securely, the two being firmly locked together during the explosion of the cartridge; and the breech cannot be opened again until the barrel, together with all its attachments, which participate with it in the recoil, has moved backwards through $\frac{1}{16}$-inch, being half of its total travel of $\frac{1}{8}$-inch. By the time they have moved back through this distance, $\frac{1}{16}$-inch, the shot is already some distance out of the barrel, and the pressure of the gases is so far reduced that is quite safe to open the breech. As the barrel recoils further, it becomes detached from the other moving parts; and while it is stopping, the breech-block with its attachments is sent rapidly backwards to a still greater distance. This further backward movement removes the empty shell from the barrel, and cocks the hammer: and then the return or forward travel of the breech-block pushes a fresh cartridge into the barrel, closes the breech, and pulls the trigger.

Seven cartridges having been drawn from the belt into the magazine of the gun, there are now six of them in the magazine, and one in the barrel. The regulating lever of the trigger has been set forwards into such a position as will cause the gun to fire very slow.

In this slow firing the whole of the various operations take place very rapidly, with the single exception of finally pulling the trigger for firing the shot. The speed of firing or rapidity of pulling the trigger is regulated by a piston working in the controlling cylinder or cataract, which has an adjustable by-pass from one end to the other (Fig. 3); the area of this passage way is regulated by a cock, and the cock is attached to the trigger lever. When the seven cartridges were fired very slowly, it was because the trigger lever was pulled back only far enough to open the cock very slightly. If the lever be pulled further back, the speed of firing will be greater; while if it be pulled completely back against its stop, the whole seven cartridges will be fired in less than one second of time.



When the barrel with its attachments has recoiled through half its travel, and has thus reached the point at which the breech-block becomes detached from it, the remaining half of its travel has then to be occupied in bringing the barrel itself to rest, while at the same time withdrawing the breech-block rapidly from it through a much longer range of backward travel. This is accomplished by the single lever L, Fig. 1, so contrived as to afford a great range of variation in its effective leverage. The breech-block is thereby driven rapidly backwards at the expense of stopping the barrel completely. Upon the return or forward movement of the block, the impact which would be expected from its closing against the end of the barrel is prevented by this same lever arrangement, whereby the barrel is caused to be already moving forward in the same direction as the block before they come in contact, thus preventing any destructive hammering between them.

In Fig. 8 is shown a diagram of the relative movements of the barrel and of the breech-block, set out upon a base-line which represents the length of the circular path described by the crank. The lower area shows the short travel of the barrel; and the upper area shows where the breech-block parts company with the barrel, and how it then continues its much longer travel while the barrel is stationary, and how it afterwards overtakes and rejoins the barrel in the return or forward travel. Below the actual base-line is added also a dotted line, for indicating what would have been the virtual base-line, had the crank been arranged to make a complete revolution, instead of which it is a fundamental feature of this gun that the crank stops short on each side of its front center, and rotates forwards and backwards alternately through somewhat less than a whole circle.

On introducing a belt of cartridges into the gun, and turning the crank handle, the cartridges are drawn in one by one, until the magazine is full, that is, until it is filled round half its circumference up to the barrel, and empty round the other half; and the empty part of the belt hangs out from the opposite side of the gun. On pulling the trigger by hand, the first one of these cartridges is fired; and the gun will then supply itself from the belt and continue firing automatically as long as there are any cartridges in the belt. The firing can be stopped after only a single cartridge has been fired, or after two, three, or any other number up to a whole volley has been fired; and the gun can be made to fire either slow or with great rapidity. It is the first shot alone that requires to be fired by hand, after which the firing goes on automatically until stopped.

Hang Fire. Suppose that any of the cartridges supplied to the gun should hang fire. At the instant of the cartridge being struck the breech is closed, and there is no power to open it automatically except the power locked up in the cartridge itself. This power does not develop itself until the cartridge itself explodes; consequently the breech does not open until after it has exploded, and the cartridge cannot be withdrawn in the act of exploding, as it can in other guns. Thus the serious trouble occurring with all other machine guns in cases of hang fire cannot here occur, being rendered impossible by the very principle upon which the gun is constructed.

The case of a cartridge entering the barrel and failing to go off at all may be exemplified by placing in the magazine of the gun two good cartridges, then a bad one, and then two good ones. As soon as the first cartridge is in the barrel and has been fired by pulling the trigger by hand, the gun will fire the second cartridge automatically, and will attempt to fire the third or bad cartridge, but will fail. The bad cartridge has then to be removed from the barrel by working the crank handle by hand: the fourth cartridge has, like the first, to be fired by hand; after which the gun will fire the fifth automatically. The whole operation of passing the bad cartridge will occupy about half a second.

Hence, if a cartridge hangs fire, the gun wait for it, if it fails to go off at all, it must be removed by hand, which is done in about half a second.

Adjustment.—As the gun requires no external power for working it, being wholly self contained, it may of course be turned freely in any direction while firing. For target practice, and for accurate shooting at long range, it is convenient to train it with screws, as in the case with other machine guns: and suitable adjusting screws are accordingly provided.

Suppose however it be required to give a quick adjustment as to elevation. For this purpose the clamping screw is slackened on the telescopic elevating streut, and in a second the required elevation is approximately given; after which the clamping screw is tightened up, and a final true adjustment is given in the ordinary manner by the fine regulating screw. Again, if it be required to spread the fire horizontally between two given points, as across a bridge or a ford or a pass; or to take accurate aim in daytime upon a part of the enemy's position where he is expected to be at work at night; in such case the horizontal adjustment towards the right hand side is made with one adjustable stop, and towards the left hand side with another. The two stops can be set so as to give any spread that is wished and to give it in any position desired. When so adjusted the gun can remain in this position still wanted, and can be fired in the night or at any other time with the certainty of covering everything between these two points without getting out of adjustment. For receiving cavalry or a sudden charge, the gun is clamped in elevation, but is left free to be moved completely round horizontally. For firing upon a quickly moving tor-

pedo boat, it is wholly unclamped so as to be moved freely in all directions.

The gun here shown is the size known as rifle calibre which would doubtless be of great service in the field.

Naval Gun.—For naval purposes a very much larger gun is required, having sufficient power to destroy a torpedo boat completely at a single shot. For this purpose the writer is now making a gun large enough to take a cartridge with a shell 1¾ inches in diameter and 6 inches in length, the shell, or projectile, having a percussion fuze and sufficient power to give great penetration and a very long range, with a muzzle velocity of 2,000 feet per second. This gun will be capable of being fired at the rate of about 150 shots per minute; but as the time that a torpedo boat will be in sight before she is near enough to destroy the ship is only from about ten to twenty seconds, it is not expected that it will ever have to be worked during a whole minute at its full speed. What is required is to fire a very large number of shots in a very short space of time. A six pounder capable of piercing about 4 inches of steel plate could be fired about fifty times per minute.

How Much it Costs to Produce the Incandescent Electric Light.

BY FREDERICK EGNER.

The cost of lighting by the Edison incandescent system a certain town in the West for the months of last November, December and January was as follows:

Engineer (for the three months all told)			$165.00
Engineer's helper	"	"	90.00
Electrician	"	"	135.00
Coal (at $1.65 per ton)	"	"	346.00
Oil and waste	"	"	29.10
Incidentals	"	"	16.95
Broken lamps (at 50 cents each,) 3 months all told			162.00
Total, exclusive of office expenses, wear, tear, etc.			$944.05

Lights connected, though not all used—in fact, not quite one-half were used.

Nov., 1,004 ten-candle power lamp, and 195 sixteen-candle power lamps.

Dec., 1,057 ten-candle power lamps, and 197 sixteen-candle power lamps.

Jan,, 1,412 ten candle-power lamps.

But suppose if the whole outfit had been used, and it would have cost the same to operate the entire lot, the light furnished would have been equal to 637,480,960 grains of sperm. Divide *that* with with the value of a cubic foot of your gas, my reader, and you will know what gas ought to cost you in the holder, if you were required to compete with a similar incandescent electric lighting plant.

For the benefit of those who may not be acquainted with the rule for finding the value of a cubic foot of gas, the following quotation may be of use: "Multiply 120 (the grains allowed per hour for the consumption of the standard sperm candle) by the illuminating power, and divide by 5 (consumption of gas in cubic feet per hour by the standard burner). The answer will be the value of gas in grains of sperm per cubic foot." For instance: What is the value of a cubic foot of 20-candle gas?

$$\frac{120\times 20}{5} = 480 \text{ grains of sperm.}$$

In that way we find that the light given by the electric plant in question, for those three months, was equal to that which would have been given by 1,328,000 cubic feet of 20-candle gas; and dividing the cost of the electric light—$944.05 by the 1,328 thousands cubic feet of gas it represents, we find that gas ought to have cost 78.6 cents per 1.000 cubic feet in the holder in order to be as cheap as the electric light was. It should have been mentioned that the electric lamps were kept burning only about 4 to 4½ hours each night. If you are so situated that coal would cost more than $1.65 per ton; and that skilled labor could not be had quite so cheaply, that is all the better for *you*, my fellow gas man.

The results quoted are from one of the "show towns" of the the electric light propaganda; hence, of the best. If, in the preceding case, we counted only the lamps actually in use, then the relative cost of gas would have been $1.63—in the holder, don't forget; but it is fair to assume that to light all of the lamps would cost but very little more. The so-called 10-candle and 16-candle power lamps are found generally to be nearer 6 and 11-candle power than that claimed for them. The writer might go on and quote from the results obtained in two other towns lighted up in the same manner; but the one cited showing best—that is, in favor of the electric light, will do. Yet one more may be mentioned briefly. The assertion was made by the manager of one of these companies that the average cost of maintaining a 10-candle power lamp was two-tenths of one cent per hour. All this is exclusive of wear and tear of machinery, which latter, owing to the high speed that must be maintained, is not a trifle. On figuring up the detailed expenses of the latter gentleman's statements, it was found he had made a mistake somewhere, as, according to his own data, it really cost four-tenths of one cent per lamp per hour. Next in order is the incandescent gas burner—and look to your gas stock now; but when about to weaken, think of the electric light, and how, not long ago, it was to wipe out all gas works.—*American Gaslight Journal.*

"Pumping Hot Water."*

BY HENRY JAMES COLES, ASSOC. M. INST. C. E.

The depth from which hot water of a given temperature may be pumped can be theoretically deduced from the formula

$$\log. p = A - \frac{B}{t} - \frac{C}{t^2},$$

and the inverse of the above

$$\frac{1}{t} = \sqrt{\left(\frac{A - \log. p}{C} + \frac{B^2}{4C^2}\right)} - \frac{B}{2C}$$

in which p = absolute pressure, t = absolute temperature and A B C are constants. Both formulas are quoted from p. 283 of Rankine's "Rules and Tables"; or the same results may be more readily obtained from Regnault's Tables given at p. 263, Ganot's Physics (3rd edition).

Having had, however, frequent inquiries as to what could be done in actual practice by donkey-pumps for feeding boilers from hot-wells, etc.; and supposing that possibly sufficient vapor might be evolved from the water at lower temperatures than those ascertained by the above rules to diminish seriously the quantity pumped, the author carried out a series of experiments to obtain actual results.

The donkey-pump employed was single-acting, having a ram 3 inches in diameter, with a length of stroke of 7 inches. The pump was elevated to various heights; but the results being so nearly alike, allowing for difference in height and temperature, the Table given below for 15 feet may be taken as typical of all. The supply-tank stood on the ground, the water in it being heated by a jet of steam. The suction-pipe was led direct to the valve-box with only one bend, and the delivery-tank was elevated to about the same level as the pump, the water being discharged through a valve loaded to 60 pounds per square inch. A large cock, fitted to the bottom of the delivery-tank, was kept open while the speed of the pump was being regulated, and was shut as soon as the trial commenced. A certain depth of water always existed in the tank while the cock was open; this was carefully gauged and deducted at the end of the trial. The speed of the pump was regulated as nearly as possible to that given in the first column, and on each trial, as soon as the exact number of strokes was completed, the pump was stopped.

It will be seen that the results agree closely with those given by the above rules, the falling off in the quantity at the higher temperatures being most probably due to the friction of the water in passing through the pipes, valves, etc. It will also be observed that the speed of the pump had to be reduced for the higher temperatures, the speeds stated in the list being found to give the best results.

RESULTS OF EXPEIMENT NO. 3 WITH THE PUMP 15 FEET ABOVE THE WATER-LEVEL.

Revolutions.	Temperature Fahrenheit.	Hot Water Pumped per Minute
Per Minute	°	Cubic Inches.
70	70	3,430
70	100	3,430
70	120	3,430
70	140	3,430
70	160	3.286
60	170	2,682
50	180	2,180

Each quantity stated is the mean of several trials. Above 180° Fahrenheit scarcely any water could be pumped. According to Regnault, 185° would be about the limiting temperature at 15 feet.

*From Proceedings of the Institution of Civil Engineers.

Making Sea-Water Potable.

The introduction of a simple method of making sea-water potable would be a great boon not only to mariners cast away in boats, but to our naval forces. Mr. Thomas Kay, president of the Stockport Natural History Society, has recently given his attention to the chemical aspect of the question, and brought the subject before the Manchester Literary and Philosophical Society, taking Schweitzer's analysis of sea-water off Brighton:

Sodium chloride	27.059
Potassium	0.766
Magnesium	3.666
" bromide	0.0.9
" sulphate	2.296
Calcium sulphate	1.406
" carbonate	0.033
Iodine and ammoniacal salts	traces
Water	974.795
	1000.000

Along with some other observations Mr. Kay concludes that the proportion of chlorides in ocean water to be taken as a basis of calculation is 32 per mille, representing about 20 per mille of chlorine. The chlorides of sodium and magnesia preponderate, and it is to the former of these, namely, common salt, that sea-water chiefly owes its baneful effect as a drink. It produces thirst, probably by a styptic action on the salivary glands, and scurvy by its deleterious action on the blood when taken in excess. Further, since soda in combination with a vegetable or organic acid, such as citric or tartaric acid, is innocuous, Mr. Kay infers that chlorine is the evil element to be removed from sea-water. In order to do this he mixes the sea-water with certain salts, such as silver citrate and citric acid. At the Manchester meeting he treated a pint of water from beyond the Eddystone Lighthouse with 960 grains of citrate of silver and four grains of free citric acid. Each part of the chlorides requires three parts by weight of the silver citrate to throw down the chlorine, thus: $3\,Na\,Cl + Ag_3\,C_6\,H_5\,Oy = Na_3\,C_6\,H_5\,Oy + 3\,Ag\,Cl$. The silver chloride formed a dense precipitate in the sample thus treated, and the overlying insoluble liquid being decanted and filtered through a rubber tube was handed round the meeting as a beverage.

In each fluid ounce it contained 18 grains of citrate of soda, 1½ grains of citrate of magnesia, ½ grain of citrate of potash, 1 grain of sulphate of magnesia, ½ grain of sulphate of lime, ¼ grain of citric acid, with less than ¼ a grain of undecomposed chlorides. The salts of soda in this liquid are diuretic, the salts of magnesia aperient, and the salts of soda neutral, except in excessive doses or in combination with acids of varying medicinal action. Thus soda in nitric acid, or nitrate of soda, is diuretic, following the law of nitrates; whilst soda in combination with sulphuric acid, as sulphate of soda, is aperient, following the law of sulphates. The converted sea-water is thus to some extent a kind of mineral water with medicinal properties. It could be used to moisten the tongue and throat, and even be drunk in small quantities. The bulk of the solids in it is in the form of inert citrate of soda. There is a little citrate of potash, a feeble diuretic, a little citrate and sulphate of magnesia, a slight aperient, corrected, however, by the constipatory half-grain of sulphate of lime. The citrate of silver employed for precipitating the noxious chlorine must be kept from light, air, and organic matter, as it is easily decomposed. A stoppered bottle covered with india-rubber was exhibited to the meeting as a suitable holder for the salt. As one ounce of citrate of silver will convert half a pint of sea-water into a drinkable fluid, and a man can keep alive upon it for a day, seven ounces of it will, it is presumed, keep him alive for a week. The bottles containing the salt could be stowed under the thwarts of the lifeboats in ocean going vessels. It might even be added to the new life-buoys now made. —*Engineering.*

Uniformity in the Preparation of the Annual Reports of Water Works.*

BY C. P. COGGESHALL AND WM. R. BILLINGS, COMMITTEE.

It has long been admitted that if there could be established a degree of uniformity in the preparation of the annual report, some standard which would be recognized and adopted by all water departments, a result of great value would be secured and a need long felt be supplied.

Your committee are not the first to suggest some scheme bearing upon the solution of this somewhat complex problem, for it has received attention at every gathering of the American Water Works Association since the first meeting at St. Louis in 1881.

The fact that the problem has been assigned to us by the New England Water Works Association might seem to indicate that previous solutions were not entirely satisfactory, and it is with no little diffidence that we present this attempt, but if our work can serve as a foundation upon which others may build we shall be content.

To secure attention in this busy age results should be presented in such a way as to be seen and comprehended with the least possible loss of time. The annual reports of water departments are yearly becoming of more value and interest to a circle of readers outside of the tax payer and consumer. According to Mr. Croes' tables there are 1008 cities and towns in the United States and Canada having a public water supply, and a carefully prepared report from the smallest of these can hardly fail to contain items of interest.

The great variety of methods employed in administering the affairs of water departments, and the great variety also in the titles and duties of the officers, make entire uniformity in the reports coming from the various sources practically impossible.

We make bold to say that it is a mistake to conceal results even though they do not always bring the highest praise to the management.

The city or town is fortunate which has not its mistakes to record, and an honest mistake in judgment should not be regarded as a stigma. Annual reports should be volumes of condensed experience presented in such form as to make them acceptable guides for future practice.

As samples of defects now common in annual reports, the following may be presented. The attempt is often made to draw comparisons between the statistics as presented by two or more towns. For instance, we turn to the financial statements, for the purpose of comparing the total expenditures on account of maintenance, and find at once that the methods followed by the two officials in making up the statements, are so different that exact comparisons cannot be made. Again, the word "duty" as applied to pumping engines has a meaning which varies according to the methods employed in its determination. We see, then, with results expressed apparently in equivalent terms, that the factors used in obtaining them are so different in each case as to render satisfactory comparisons impossible, and therefore it seems necessary not only to agree upon a form of statement which shall classify all the results considered of importance, but processes and formulæ minutely prescribing just how the stated results shall be obtained, must be adopted, and carefully followed.

Could perfection be attained in this direction it is possible that a satisfactory solution could be reached of certain important questions which seems to remain at present open to discussion. For instance, it is doubtful if the question "Should direct pumping ever be chosen in preference to pumping into a reservoir," will ever be satisfactorily and fairly answered until annual reports from cities and towns, some having one system and some the other, are sufficiently uniform and complete to make possible exact comparisons of conditions and results for a large number of cases.

Another defect to be noted in reports, as generally presented, is the lack of attention given to the description of experience in matters of seemingly small moment. These items are passed over each year on account of the attention demanded by the larger and more important results.

We are often for a time perplexed with some trivial difficulty which, we are quite sure, must have occurred many times elsewhere, but as no record of such an occurrence has ever been made we do not know where to obtain the information we want. Your committee feel very sure that the value of annual reports would be largely enhanced if more attention were given to these minor matters.

The address and certain features of the report will always have to remain subservient to plans of department organization in which there is so much variety. In most cases the actual management is entrusted to the care of two or three persons. In the larger cities there are generally at least three subdivisions of the management, viz: "Engineering." "Finances," "Superintendence." In the smaller works all these matters may be entrusted to the care of one person. Your committee feel it important to urge that in all cases the person actually having charge of the details of a work is the proper one to make the report thereon. The report of the manager should, of course, be addressed to the board or committee who direct the affairs of the department, and in turn the report of the board or committee should be very brief and general in its statements, referring to the manager's report for all details.

After due consideration of the topic assigned us we have come to the conclusion that perhaps our work can be best accomplished by preparing a specimen annual report, stating as concisely as possible what matter should be included in its pages. You are now invited to inspect the result of our labors in the pamphlet laid before you. We think the scheme needs very little explanation. It has been our endeavor to put into practical form the principles set forth in this paper. The following hints may secure a better comprehension of the plan:

A division of statistics is made into two classes, viz: general and special. The first includes only those broad topics which are of interest to all, and the results most needed and used in making comparisons. The second class contains the details, or three results having mainly a local interest. It is suggested that all statistics, both general and special, should appear in the body of the report under their appropriate headings, while the general statistics alone, are grouped in classes and placed in every report, just following the title page. We feel very sure that this is the most appropriate place for such a statement, as, thus placed, it will naturally receive examination before attention is given to the details of the report.

For assistance in making comparisons, each item of the general statistics is designated by letter or number, for example:

Duty comes under the division: Pumping (10.)

Daily average consumption under Consumption (7.)

Receipts from Water Rates under Financial (c.)

As an illustration of what is possible, we place before you statistics drawn from the last reports of the departments of Trenton and New Bedford, and it is evident that the list may be indefinitely extended.

If some such plan as this be adopted a committee of this Association might each year draw from the reports of all the water departments represented in this organization these important facts and, having tabulated them as shown, furnish a copy to each member.

Each member would then have directly before him in the most concise form for immediate reference and comparison a convenient compilation of the yearly work done by water departments, throughout such territory as it may be decided best to cover by such a scheme.

Before closing we wish to testify to our appreciation of the valuable work done in the compilation of water-works statistics by Mr. Croes, also to acknowledge having included in our work some valuable ideas advanced by Messrs. Croes and Price in their paper presented at the last convention of the American Water Works Association. We are also indebted to the *Sanitary Engineer* and to Messrs. Gerhard, Ellis, Sherman, Brown, Taylor, Schleiter, Wilcox, Dennett, Rogers, Walker, Hyde, Chase, Holden, Horan and Richards for statements in reply to our inquiry as to what they considered most of interest in the make-up of an annual report.

Your committee would now conclude with the suggestion that this scheme be examined in detail by the convention and that it receive such revision as to make it worthy of the endorsement of this association, and finally that action be taken to induce as far as possible every water department in the organization to adopt it as a model in compiling its annual report.

* Read June 19, before the Springfield, Mass., meeting of the New England Water Works Association.

Construction of a Dry Dock in Quicksand.

This dock was built at Hamburg for the Hamburg-American Steam Packet Company. The only available site was a narrow strip on the bank of the Elbe, perpendicular to the river, partly below high water, and the soil so loose and porous that it would only stand at a slope of 1 in 4. The excavation was 300 feet long, 66 feet broad, and about 23 feet below low-water level as a maximum. Want of space precluded the formation of a coffer-dam of several rows of sheet piles of varying heights, (which would have been the safest arrangement) so it had to be constructed of a single line of sheet piling, which not only had to support the entire pressure of the surrounding soil, but, owing to its unavoidably imperfect water-tightness, allowed the water to percolate through the sides. The first step, therefore, was the setting up of four turbines for pumping out the water. The work demanded of them was the lifting of 25,276 cubic yards a maximum height of 23 feet in 3½ hours, but they did it perfectly in half that time—that is, they lifted on an average 2.42 cubic yards per second.

In order to limit as much as possible the depth to which the piles had to be driven, the bottom of the dock was not made horizontal but rounded, to correspond with the form of a vessel, so that to drive the piles down to 23 feet below low-water level was sufficient. The space inclosed by the piling was then dredged out. The concrete employed for the foundation was formed of 9 parts Luneburg lime, 7 trass and 16 sand, mixed with twice that volume of broken stone, and was at first shot out for the entire thickness of the floor of the dock at once, by means of a wooden chute or funnel attached to a travelling crane; but this arrangement did not answer well, for the shute often splintered and broke, so that an iron one had to be substituted. After the concrete had lain three months under water, the water was pumped out, and the concrete, though not perfectly set, was found sufficiently water-tight. Splinters of the wooden shute were found in the concrete floor, and their removal caused strong springs or leaks, but these were successfully stopped by iron cement.

On the concrete floor the side and front walls were built of brickwork, and carried up to summer flood-level, with a rebate or recess for a caisson, and all round the dock is a quay-wall reaching above highest flood-level. After a time it was observed that the butting of the caisson against the walls loosened the mortar, and the recess was not water-tight, but it was made completely so by a facing of planed cast-iron with concrete backing. The weight of the empty dock alone is not sufficient to resist the upward thrust of the water at very high tides, but when loaded with the weight of a ship there is, of course, an abundant margin; and when no ship is in dock it is arranged that so much water shall be admitted as will satisfy the conditions of safety. The work was carried out in 1868 to 1870, and cost $925,000.

Hydraulic Lime.

Hitherto this useful building material, although in very general use in Europe, has been almost unknown in the United States, owing probably to the high cost of importation. In France the famous hydraulic lime of Teil, manufactured at the rate of 10,000 barrels per day, is very generally used for brick, stone and concrete work.

The ordinary quick or "fat" lime so universally used in this country for mortar has no inherent *setting* properties, and when used in a wet or dark place will never harden. General Treussart in 1822 found in one of the bastions of the citadel of Strasbourg, built in 1666, that the mortar used in its construction was still soft. In free contact with the air, lime mortar dries out, and under favorable circumstances slowly absorbs carbonic acid from the atmosphere. Experts assert that ordinary lime mortar laid in the interior walls of brick buildings does not get thoroughly carbonized and hardened for fifty years. That the process of recarbonization is a very slow one may be seen by examining mortar after it has been in a wall for a lifetime. Moisten it and it can easily be crumbled.

On the other hand, if lime mortar is subjected to exposure, as in the case of chimney tops, outer courses of brickwork, etc., rain and extremes of heat and cold are sure to disengage the mortar and allow the bricks to tumble out of place. *The process of recarbonization does not keep place with the disintegrating influences of the elements.*

In case of fire, common lime mortar is quickly dried out, and the carbonic acid that has been absorbed is expelled, leaving the mortar a crumbling mass that has nearly or quite lost its cementing properties.

Hydraulic lime has inherent *setting* qualities, and the water of mixture is retained and becomes the water of crystalization. This hydraulic property renders it peculiarly valuable in many varieties of work, notably in foundations, cellars, bathrooms, kitchens and laundries, as moisture only serves to harden it.

Architects and builders often require a mixture of common lime and cement to give mortar hydraulicity and strength. This forms a hydraulic lime mortar, but the combination is only *mechanical*, whereas in natural hydraulic lime mortar the combination is strictly *chemical* or a true *silicate of lime*, the only mortar-making material that can endure for ages the disintegrating effects of the sudden and extreme variations of temperature and other changes in our climate.

In case of fire the extreme heat will only serve to glaze hydraulic lime over and cement the material together all the more firmly. In a few days after it is used, hydraulic lime begins to change and gradually hardens. At the end of a month it will appear like cement and in time will become as hard as the material which it binds together.

Hydraulic lime as prepared for market is pulverized as fine as flour, and needs only to be mixed with sand and water to be ready for use. It requires no slacking; will keep for a year or more in barrels or sacks without deterioration; it has all the smooth and slow working qualities and the sand carrying capacity of common lime, and when used for plastering requires no hair and does not "pop out" or blister.

Many fine structures have been erected in Europe of concrete made of three parts of lime of Teil and one part of water mixed with ten parts of sand, incorporated with an equal bulk of broken stone or coarse gravel.

Of the Vanne aqueduct for supplying water to Paris, thirty-seven miles have been executed in this concrete; in the forest of Fontainbleau there are about three miles of arches, some of which are fifty feet high, the whole structure, including arches and pipe, is one mass of solid masonry without joints. A Gothic church at Vezinet, near Paris, having a spire 130 feet high, is also a monolith of concrete of lime of Teil.

The lighthause at Port Said, the northern terminus of the Suez canal, is also built of concrete of Teil lime and Port Said sand, and is a monolith 180 feet high.

The jetties which form the harbor of Port Said are built of huge blocks of concrete formed of the same material. In their construction 120,000 tons of Teil hydraulic lime were used. There were 25,000 blocks, each weighing twenty-five tons. The docks of Marseilles were constructed of similar concrete. At the harbor of Algiers, commencing in 1833, the French constructed blocks of hydraulic lime concrete, containing 353 cubic feet each, to withstand the force of the sea. The blocks weigh about twenty-five tons each. The harbor works of Alexandria, Egypt, consumed 175,000 tons of Teil lime in the construction of concrete blocks, similar to those of Port Said. —*Exchange.*

The Iron and Steel Industries.

The report of George W. Cope, Esq., Secretary of the Iron and Steel Association, to May 15, 1885, shows that the pig iron product turned out in the United States last year (1884) has been exceeded in but three former years, the statistics since 1879 being as follows.

	Net tons.
1880	4,295,414
1881	4,641,564
1882	5,178,122
1883	5,146,972
1884	4,589,613

Pig iron was produced in twenty-three States and one Territory (Washington). Maine and Minnesota dropped out of producing pig iron during the year and North Carolina resumed it. Illinois increased her previous production by 38 per cent. and Alabama by 10 per cent. The Lehigh Valley, of Pennsylvania, fell off in production 25 per cent., Pittsburg 18 per cent., the Schuylkill Valley 17 per cent., New York 28 per cent., while the lower Susquehanna and miscellaneous bituminous districts of Pennsylvania increased its production. New Jersey and Missouri declined 40 and 42 per cent. The furnaces south of Pennsylvania and Ohio, excluding Missouri, turned out 6 per cent. less pig iron in 1884 than in 1883. Since 1880, however, the South has advanced her production from 397,301 tons to 657,599 tons.

In 1884 the decline in production of iron and steel rails is somewhat greater as compared with the production of 1881 and 1882 than with that of 1883.

In the production of steel rails Illinois holds the second place, her production being 294,458 tons, against Pennsylvania, 775,872 tons; the next States to Illinois being New York, 31,625 tons, and Ohio 25,175 tons. Illinois rose from a production of 17 per cent. of the total rail production of the country in 1883 to a production of 26 per cent. in 1884. (The production of steel rails in Illinois last year was about equal to the usual annual importation of iron and steel rails into the United States prior to 1860, when our supply was almost exclusively foreign.) The production of iron ore by the Lake Superior region last year has been exceeded by only one previous year. For 1884 it was 2,455,924 gross tons; for 1882 it was 2,947,392 gross tons. The total consumption of domestic iron ore amounted to 7,639,581 tons for 1884, against an importation of foreign ore of 487,820 tons.

During the year three iron sailing-vessels and thirty-one iron steamships have been built, having a total tonnage of 35,632 tons, a decrease on the work of 1883 of 4,014 tons. The passage of the Dingley bill, relieving American shipping from onerous taxation and other burdens, and the insertion into the post-office appropriation bill at the last session of Congress of a clause authorizing the payment of 50 cents per mile to American vessels carrying foreign mails, will afford some relief to ship owners during the coming year.

The increase in mileage of railroads during 1884 was only 3,950 miles, being less than any year since 1878, but greater than any year prior to 1878 except the years 1869 to 1872, inclusive. Excluding two forms of imports of iron and steel, viz., wire-rods and tin-plates, the whole of the remainder of our imports of iron and steel become about $3,000,000 less than our exports of iron and steel, which were $19,303,150.

Altogether the iron and steel industry of the country has held its own in quantity during 1884 under a decline in prices which has been unprecedented. The average price of bar iron for 1884 was $44.05, which was lower than any other year in the history of the country, the nearest approach to it being the average price of 1878, which was $44.24.

Cross-Ties.

The report made by F. B. Hough, of the Department of Agriculture, on the "Durability of Cross-Tie Timbers," is important both to the railroads and to the owners of woodlands. The cross-ties needed for railroad construction are a heavy draft upon our forests. In France and England the country does not raise sufficient timber to furnish ties, and they have to be imported from abroad; and in Mexico and South America, nothwithstanding the great forests, many ties were similarly imported. In this country, on the other hand, we are exporting them; but the time will come when the demand will test the supply. It requires 17,000,000 acres or 26,500 square miles of forests to furnish the present demand of the railroads, and at the rate of progress in building new lines 30,000 square miles of forests will have to be set aside for this purpose within a decade.

The principal timbers employed for railroad purposes are the following, given in the order of their use: Oak, pine, chestnut, hemlock, cedar, tamarack, cypress, elm, ash, cherry, black walnut, fir, spruce, beech, locust, redwood, maple, butternut, coffeenut, mulberry and mesquite.

The oak lasts seven and a half years as a cross-tie, and costs 41 cents per tie. Red oak, however, lasts only five years, and black oak four and a half. Southern pine is good for six and a half years, and costs 37 cents; white pine has the same durability, but costs less, 31 cents.

Cedar shows the greatest average durability of twelve years, with a cost of 34 cents, but it is too soft to bear heavy freightage and is consequently not much used in railroad building.

California redwood is also very durable and lasts eleven years, but this, it must be remembered, is in the dry climate of California, where all kinds of timber lasts well.

Cypress makes a good cross-tie, lasting nearly nine years where white and black ash rot in four years. Finally, all hewed woods are much more lasting than when sawed.

The present price paid for cross-ties in the the United States—an average of 35 cents, is phenomenally low in comparison with other countries, and is due to the fact that so many of our railroads traverse well-wooded districts. It is inevitable that with the destruction of our forests their price will rise, and that our railroads of the future will find crossties among the most expensive articles of construction.

CLEANING TOOLED GRANITE BASES. Get a scrubbing bursh and wash the dirt and grease off with sulphuric acid or spirits of salt. Rinse off with clean water afterwards.

The Clapp-Griffiths Steel Process.

The experiments that have been made by skilled metallurgists within the last few months of the new Clapp-Griffiths steel process conclusively settle whatever doubt may have existed of the commercial value of the process. The steel used in the tests was obtained from the plant erected last year by the firm of Oliver Brothers & Phillips, of Pittsburg. The converters used in operating the process are stationary, with removable bottoms, each holding from two to three tons. The blast, instead of entering through tuyeres in the bottom of the vessel, as in the Bessemer process, passes into the converter through the sides some little distance above the bottom. While this change has been thought to be only a simple mechanical modification of the Bessemer converter, it has an important bearing upon the steel produced, causing, by the rapid oxidation of the iron, the almost entire elimination of the silicon. The converter also has a slag tap-hole, situated at such a distance above the tuyeres that when the slag forms and boils up it will run off. After the melted pig metal is charged into the converter the blast, which varies from five to eight pounds pressure, is turned on, and the blowing is continued for from ten to twelve minutes. When all the carbon has been removed from the iron the blast is reduced by an ingenious arrangement of machinery to a pressure sufficient to keep the tuyeres clear, generally about two and a half pounds, and the metal is then run into a ladle, at which stage of the process the necessary quantity of ferro-manganese, previously broken into small pieces, is added.

Although by the Clapp-Griffiths process the decarbonization of the iron is effected in the same manner as by the Bessemer process, by the blowing of air at pressure through the molten mass in the vessel, yet the different arrangement of the plant and the method of working produces a steel that differs in a number of important respects from the product of the Bessemer process. While the Bessemer process removes neither the phosphorous nor silicon from the pig metal the Clapp-Griffiths process produces a steel that is almost entirely free from silicon, but it does not remove any of the phosphorous, there being, in fact, a higher percentage of that metal in the resulting steel, caused by the the quantity which was in the iron at the commencement of the process remaining throughout the blast, while a certain quantity of the metal is lost in conversion.

The experiments that have been made with the Clapp-Griffiths process has created quite a sensation in engineering circles by their results. Ever since the introduction of the Bessemer process the presence of phosphorus to any appreciable extent in steel has been considered by engineers and railroad men to render the metal useless for the production of rails, plates, or any other form of manufactured steel, and it was to remove the large percentage of phosphorus in some grades of pig iron, and also to enable steel manufacturers to use the large deposits of iron ore too high in phosphorus for the Bessemer process, that the basic process was introduced. Since the Clapp-Griffiths steel has been tested it has been found that as long as the silicon is removed from steel the presence of a large percentage of phosphorus in no way interferes with the quality of the metal. Steel produced by this process containing .54 per cent. of phosphorus, but with only a trace of silicon, when rolled into test bars, bent double when cold without the slightest sign of fracture, and when worked hot the behavior of the metal was all that could be desired. By what means the silicon is removed has not as yet been thoroughly determined, but experts are of the opinion that the early oxidation of the iron forms a base which eliminates the silicon of the bath when the cinder runs off.

It is to manufacturers who have heretofore made wrought-iron that the Clapp-Griffiths process is especially valuable. We doubt if there is an iron rolling-mill owner who has not been sensible to the serious inroads that steel has been making during the past few years into the iron business. The iron-rail industry, which a decade ago was one of the leading branches of the iron trade, has been almost totally extinguished by the competition of the steel rail, and the manufacturers of iron nails cannot fail to see that their business is in danger of sharing the same fate by the competition of the steel nail. All branches of the manufactured iron trade feel the effects of the competition of steel.

To the blast furnaces of this country the Clapp-Griffiths process offers advantages that are equal if not superior in question of cost of production to the benefits which the rolling mills would derive from operating. While the cost of erecting the plant at blast furnaces would be about the same as at rolling mills the cost of producing the steel would be less. At blast furnaces there would be a saving as compared with rolling mills in the cost of labor, in the remelting of the pig iron and on freights. Between each cast at furnaces the majority of the workingmen have little or no work to perform, while a few have only to prepare the casting-bed for the next cast. With converters connected with the furnace the preparation of the casting-bed becomes unnecessary, and the main body of the men around the furnace could be employed in converting the pig metel into steel as it comes from the furnaces. Besides saving the cost of transporting the pig iron to the mill, the time, labor and fuel necessary to remelt the pig metal would be a clear gain in favor of the blast furnace. Of course the furnace would be compelled to pay the freight on the steel to the rolling mill. That it is possible to take the molten iron direct from the blast furnace and convert it into steel has been fully proven by a number of Bessemer steel manufacturers in this country and abroad who produce steel direct from the furnace.

A careful estimate places the cost of converting pig iron into steel by the Clapp-Griffiths process at from $3 to $4 a ton at blast furnaces, and about $6 a ton at rolling mills. As compared with the other steel-making processes the cost of erecting a Clapp-Griffiths plant is small, and this fact alone will lead to the extensive introduction of the process into the different iron works of the country. At an expense not exceeding $60,000 a plant of two converters could be built, including all machinery and necessary buildings, which would be capable of producing from 80 to 100 tons of ingots in twenty-four hours. Another fact that especially commends the process to the established iron-rolling mills is the facility with which the steel may be rolled, enabling rolling mills equipped with machinery of fair strength to use it for the manipulation of this steel. When it is also considered that the process permits of the use of a cheap grade of pig iron and produces a high grade of steel at a cost far below that necessary to manufacture muck bar, and that the operation of the plant requires no skilled labor, it will be seen that the process can successfully compete with either the slow and expensive open-hearth furnace or with the Bessemer converter. It is not to be expected that the new steel will go into rails in competition with Bessemer steel rail manufacturers, but it will be in the smaller forms of steel, such as plates, sheets, nails, tacks, wire, rivets, washers, angles, shovel-plate, pipe strips, and a number of other light forms of steel that its competition will be felt.

There is now but one Clapp-Griffiths steel plant in this country, erected last year at the works of Oliver Brothers & Phillips, at Pittsburg, but two other plants have been contracted for, one to be built at the works of the Western Nail Company, at Belleville, Ill., and one to be built by the Cedar Point Iron and Steel Company, at Port Henry, N. Y., to be operated in connection with their rolling mill. A number of other iron manufacturers are investigating the process, and it will probably not be long before other companies will make contracts for the erection of the plants.—*Bradstreet.*

Expensive Metals.

Following are the names of those metals valued at over $1000 an avoirdupois pound, the figures given representing the value per pound:

Vanadium.—A white metal discovered in 1830, $10,000.

Rubidium.—An alkaline metal, so called for exhibiting dark red lines in the spectrum analysis, $9070.

Zirconium.—A metal obtained from the minerals zircon and hyacinth, in the form of a black powder, $7200.

Lithium.—An alkaline metal; the lightest metal known, $7000.

Glucinum.—A metal in the form of a grayish black powder, $5400.

Calcium.—The metallic base of lime, $4500.

Strontium.—A malleable metal of a yellowish color, $4200.

Terbium.—Obtained from the mineral gadolinite, found in Sweden, $4080.

Yttrium.—Discovered in 1828, is of a grayish black color, and its luster perfectly matallic, $4080.

Erbium.—A metal found associated with yttrium, $3400.

Cerium.—A metal of high specific gravity, a grayish white color, and a lamellar texture, $3400.

Didymium.—A metal found associated with cerium, $3200.

Ruthenium.—Of a gray color, very hard and brittle, extracted from the ores of platinum, $2400.

Rhodium.—Of a white color and metallic luster, and extremely hard and brittle. It requires the strongest heat that can be produced by a wind furnace for its fusion, $2300.

Niobium.—Previously named columbium, first discovered in an ore found at New London, Conn., $2300.

Barium.—The metallic base of baryta, $1800.

Palladium.—A metal discovered in 1802, and found in very small grains, of a steel gray color, and fibrous structure, $1400.

Osmium.—A brittle, gray colored metal, found with platinum, $1300.

Iridium.—Found native as an alloy with osmium in lead gray scales, and is the heaviest of known substances, $1090.

THE pay-as-you-go principle is making headway in American cities. As a Springfield, Mass., councilman said the other day, "Borrowing money at interest when the city has ready cash isn't the thing." The point was carried, thus scoring a clear advance. Borrowed money in the conduct of city business is too much like "found" money to the individual. Easy come, easy goes. The notion that a city must borrow money to get things easily and quickly has been fostered jointly by the large property-holder and the money-changer, the one because he speculates upon the morrow, the other because of the direct profit. The simple truth is that taxation is the quickest resource in an emergency. A city should carry a moderately large cash balance, but beyond this it should be able to levy and collect a tax within a week. The contrary view has almost universal acceptance, but it is certain to go down.—*Bradstreets.*

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WE have received an instalment of our special report of the Convention of the American Society of Civil Engineers, in session this week at Baltimore and Deer Park, and also list of members in attendance, but defer its publication to next week, when we will give full report in single issue.

THE attention of Contractors is especially called to the excellent list of new proposals advertised elsewhere in our pages this week. New Water-works at Cohoes, N. Y., and La Crosse, Wis.; Sewers at La Crosse, and an Iron Bridge in Bergen Co., N. J., offer opportunities for some profitable contracts even in these hard times.

BUDDENSEIK, the "skin" building contractor was sentenced to ten years in State prison and to pay a fine of five hundred dollars. The sentence is not only a just punishment for the individual offence, but it is a salutary warning to others engaged in the same nefarious business, not only in this city, but elsewhere throughout the country.

THE cry of dull times for engineers grows louder as the season advances, and there seems little probability of improvement for at least some months to come. Judging from the notices of new railroad incorporations reported by our exchanges, there are preparations being made for another "spurt" in railroad building which, it is confidently expected, will come before long. The amount of surplus capital now lying idle is beyond all precedent in the industrial history of this country; economy is the fashion and so everybody is saving so far as disposition and circumstances will permit. Civil Engineers cannot say that they are any worse off than other professions or tradesmen; a great many of them are employed in municipal work, in railway or bridge building, in water-works construction, or in private contracting; the latest comers can stay at home awhile and recuperate from college labors, those who are actually engaged will do well to hold on to the work in hand as long as possible; those who have been waiting, possibly heart-sick, with others depending on them, will need to husband their resources of money and patience, at the same time relaxing none of their efforts to find new business. In nearly all branches of trade the same complaint of extreme dullness is heard, and it is very much worse in England than it is here. It is one of the highest attributes of the Engineering profession, that it is composed so largely of industrious, careful, sober, earnest men, that, while the periods of great monetary depression pinches them severely, yet as a class they weather the storms without much murmuring or actual dire distress. This liability of periods of enforced idleness is recognized by the profession and as far as possible provided for. Civil Engineers rarely figure in police courts, and never, that we ever heard of, in the poor-house.

WE OFFER this week a list of books and pamphlets, some of which are always to be had at publishers current prices, but most of which cannot be duplicated. We are limited as to office room and at times are obliged to dispose of the accumulations that crowd us for space. Immediate advantage must be taken of the present sale: if not soon disposed of to individual purchasers or libraries, they will be withdrawn without a chance of their being again offered. An addition at 10% discount will be given on purchases of Ten Dollars in amount, *during the month of July only.*

We wish to call attention also to an advertisement on another page, of back numbers of Engineering News, wanted and for sale. We trust parties will deal directly with each other and thus save much unnecessary expense of postage, time and labor. There will be no use in writing us for back numbers previous to January 1st, 1885, after the end of the ensuing week, as we will not have any on hand.

DURING our recent vacation we were so fortunate as to secure an addition to our subscription list, which does not often come to an American class journal. We have a bona fide order to send ENGINEERING NEWS regularly to a list of 50 English gentlemen, of whom six are Dukes; seven Marquises; three Earls; seven Viscounts; one Admiral; twenty are Baronets; and five manufacturers of national celebrity; these representative Englishmen of the very highest class of intelligence in the Army, Navy, political and engineering circles of Great Britain will, no doubt find so much to interest them in the carefully edited columns of ENGINEERING NEWS, that, like the large list of intellectual aristocrats who now favor us with their generous patronage, they will, after a time watch eagerly for the coming of their favorite Yankee journal. They are all men engaged in the most practical concerns of every day life and action, and many of them have heavy investments in this country; to parties who wish to gain the notice of such a desirable list our advertising columns are always open.

We have also a carefully prepared list of all the Civil Engineers in Japan, whom we propose to worry into becoming subscribers by means of carefully directed sample copies in indefinite numbers. Many of them have names long enough to entitle them to the highest order of Japanese nobility, or even to the Mikado-ship itself; they undoubtedly form a very important class in their country, and in the now rapidly developing progress of their nation must control the purchase of vast amounts of material for public works designed and constructed by them.

An Editorial Vacation.

I

A TRIP to Europe is now so easy and inexpensive that it is quite reasonable to expect that every American who has a fairly good income will, sooner or later "see how it is for himself." In view also of the certainty of a greatly enlarged migration of our engineers, manufacturers, and inventors, next year to take advantage of the proposed benefits of the American Exhibition in London, it may be excusable in us to add a little more to the literature of an always interesting subject, drawn from personal observations during our recent vacation.

Competition in ocean passenger rates is as fierce as railway rates on land; by going early in the season better terms and cabin accommodation are secured than at a later date when every steamer is crowded, and agents maintain their most lordly altitudes and airs. A ticket to Liverpool and *return* can be had as low as $100 if taken in March or April, with a certainty of good accommodation on board ship; we advise as a first principle, however, to have nothing to do with *return* tickets, which is practically selling your freedom of choice and action for a very small amount. If the economical tourist, however, *will* insist on saving his money at the expense of his comfort and convenience, he must be careful to have all the conditions of his return accommodation endorsed in red ink on his ticket at the office of purchase; the agents in London and Liverpool claim entire independence of all agreements made by agents in New York, as the confiding tourist learns immediately after his arrival on foreign soil, when he goes to secure his stateroom for the return passage.

"Tourist tickets" are very convenient for women travelling alone, and for men who have never before ventured beyond the limits of their native village; they insure you the company of the most commonplace and melancholy looking lot of companions with whom to be hurried through the "sights," and to be stared at everywhere along the whole route. The price of the ticket is just the same as if bought at the railway offices, but with the disadvantage that you cannot change if you wish to for any special purpose, and if "personally conducted" the tourist must keep up with the party or lose the supposed advantages. "Perfect liberty of choice," of route, of companions, of hotel, of time,—should be the watchwords of the traveler, if he would reap the greatest benefit of his investment.

The cost of living in England is the same as in America; a good room can be had for $1.00 to $1.50 per day, and you can waste your strength on the garbage of cheap restaurants, or keep braced up to the fatigue of sight-seeing, according as your inclinations permit; a liberal enough allowance is five dollars per day. Less than that will hasten the necessity for a return home unless one's borrowing power helps him out. In Paris the cost of living is about the same as in New York City. The temptations to buy are greater, and money goes so easily and rapidly that keeping record of it is quite out of the question; it is advisable to have a return ticket to somewhere out of Paris, for use when the last franc is in sight.

"Tips" seem to be the bugbear cry of the average American traveler abroad; in reality they are not the burdensome nuisance that they are in our own blessed land of freedom. From one penny to one shilling, or one franc, is usual in restaurants, hotels and railway stations; it is oftener one penny than more, while in the United States the lowest "tip" is a nickel to the fiend of the whisk, who abounds in every hotel or barber shop, and a dime has no lessening effect on the tough beef steak of the average restaurant. "Tips" are taxes which *must* be paid wherever one travels, at home or abroad, and no American who has any experience of travel at home, will worry over the petty exactions of foreign countries. The man who can coolly stand the fleecing processes of New York hostelries, can smile at the "candle and attendance" items of European hotel bills.

Among the conveniences organized for tourists from this side of the Atlantic is the "American Exchange in Europe." Its headquarters at 449 Strand, London, is a wonderfully convenient location for a wonderfully incon-

venient set of offices; it has a fine suite of rooms in Paris, and advertises agencies at several other points. It is a rendezvous for Americans especially, and for many purposes is a most convenient institution. The latest American newspapers are on file there; a register of American travelers is kept, all steamship arrivals and departures at New York as well as at Liverpool and Southampton are bulletined; writing materials and desks are furnished; money changed; drafts cashed; questions answered; tickets to anywhere procured; baggage collected, stored and placed on board the steamer at Liverpool or elsewhere; and sundry other services rendered which materially lessen the perplexities of foreign travel. The fee is $2.00 for a monthly ticket, with a lower rate for a longer period. A large number of employes, mostly of a very low-priced class, are in the offices; the prospectus of the concern shows the names of some wealthy and honorable Americans as incorporators, who are, however, freed from any serious liability by the use of the word "limited" in their charter; how much actual cash resources are in the treasury of the company is known probably only to the General Manager Gillig, who certainly is a very boyish-looking individual to expect very wonderful things from. The untimely fate of the Bowles' Brothers speculation in American tourists, and the temporary misery it brought to thousands in a strange country when it burst, is a warning that should be heeded; the American Exchange in Europe is a very desirable institution and capable of rendering great service to travelers; but as a banking institution there ought to be some certain method of testing its financial ability and of securing deposits in case of its failure.

We travelled by rail from Liverpool to London, from London to Edinburgh by the "Flying Scotchman," and from Edinburgh to Glasgow, and thence to Liverpool; besides these long runs, we made numerous short trips; on the Continent we went by rail to Amsterdam, and back to Paris via Antwerp and Brussels, and we used every class of carriage. The result of our limited experience was to feel convinced that American railway managers have still much to learn; that in the important items of common politeness and civility, the American railway emyloyé is very far behind his brethern over the sea; that the long bodied American car is not so superior to the compartment coach as we so complacently assume it to be; and that it is very evident that while the American railway company exercises much ingenuity and care in the handling of baggage, the English and Continental companies take greater care of the passenger. Property has more tangible value in the eyes of American railway officials than human life and comfort, while the reverse is the case with the foreigners.

The English railway stations in the large cities are immense structures; the traveller and his friends pass in and out to the trains at will, up to the very moment of starting; there are windows in the ticket offices for each class of passengers, so there is no crowding; the stations are most liberally provided with porters to handle luggage, and get the traveller suitable compartments; there seemed always to be a surplus of coaches, so that if a compartment was objectionable, another was immediately available; the first and second class are most luxuriously upholstered, the third are well cushioned, and usually we found them clean and comfortable. The first and third are principally patronized; some roads are discontinuing the second class altogether. If one wants to be on his dignity and be silent all day, travel first class; in the third class he will meet company as good as himself, and with a little tact and ordinary politeness he will be able to pass the time agreeably. If a party of friends wish a compartment to themselves, a shilling apiece to the guard will secure the word "engaged" pasted on the window and there will be no intruder. The compartment is supposed to seat eight in first and second class, and ten in third; three of us had a second class compartment travelling from London to Edinburgh; if at night, it is a better "sleeper" than a Pullman section.

Every ticket is punched by the inspector before the train starts; at *any* station along the line a ticket is liable to be called for inspection, and just before running into the terminal the tickets are taken up. The conductor attends only to running his train, and has nothing to do with the tickets; it apparently would require a very extensive combination of employés to form a successful conspiracy against the company's funds, and we think the difficulty with conductors is very satisfactorily settled by this method of collection.

Annual Meeting of the New England Water-Works Association.

The fourth annual convention of the New England Water-Works Association was convened at the Massasoit House, Springfield, Mass., on June 18th. President Geo. A. Ellis took the chair, and about 40 members were present. Mayor Phillips of Springfield welcomed the association to the city, a few remarks were made by Sheriff Sanderson, Chairman of the Springfield Water Commissioners, and the convention proceeded to business.

Ten active members were first elected and then four associate members. Edwin Darling, of Pawtucket, R. I., the treasurer, reported receipts for dues $103.00; initiation of members, $435.00, and for assessments, $108.50; the expenses were $511.44, and the balance now in bank, $281.78.

President George A. Ellis then made his annual address; in the course of his remarks he spoke as follows of the success of the association:

Of the year now just closing, we can truly say that its record of what we have seen, learned and heard, is one brim full of interest. Adjourning from our third annual meeting at Lowell, we assembled at Newton on the 24th of September, and, through the kindness of our friends had the pleasure of viewing that beautiful city, perched upon more than seven hills and surrounded by valleys that not even Italy can surpass.

The fine display of their fire department, the efficiency of their water-works, and the liberality of their citizens were witnessed and enjoyed by most of us. On the 29th of January, in accordance with the advice of the executive committee, a meeting was held at Boston, at which members were afforded the opportunity, without formal discussions, of learning each other's experiences. And last on the 21st of April in connection with our friends of the American association, we attended, at Boston, the largest gathering of water-works officials ever held in this country, and had a meeting which will always be marked with a red letter in our memories.

The papers and discussions to which we listened, the places we visited and the public works we saw, both in their number and magnitude, have never been surpassed (so far as I am aware) by what has been seen by any association in the United States at a single session.

That so much care and thought put into our meetings should have a tendency to increase our membership and extend our field of usefulness, is self evident. And so we find it. A year ago we numbered 48 active and nine associate members, a total of 57. To-day having lost two, one by death and one by change of occupation, we number 81 active and 44 associates, making 125 in all, showing a gain of 70 members and a total more than double that which we had when we met at Lowell. By this increase of membership and by the change relating to the dues of the associate members we have raised the amount of our annual receipts from $96 to $384 or 400 per cent—a change which will be of great assistance to our treasury and ourselves, in defraying necessary expenses for printing reports, circulars, etc.

While now we congratulate ourselves upon our brighter prospects, we must not forget our increase of responsibilities. New England is to-day the most thickly settled portion of the country, and has by far the greater number of water-works, in proportion to its area, so that as we increase our members, and thereby more and more thoroughly represent New England, it more and more devolves upon us to apply ourselves to the study of those problems that everywhere demand the attention of water-works men, or more especially the public whom they serve. Our experience of the last three years has shown us some of our weaknesses and the advisability of some changes in order that we attain the best results.

The first suggestion relates to our constitution. Continual tinkering of it is to be deplored, and it would seem as if with our present experience we ought to know pretty nearly what we need. I therefore recommend that our constitution be put into the hands of a committee for revision, they to report in print at least a month before our next annual meeting. It would seem desirable that the terms of our membership be so broadened as to admit as active members all who are actively engaged in the construction or management of water-works. I confess that I am not one of those who are afraid of admitting any who have this interest, for it seems as if the greater the number interested, the greater should be the benefits derived. Other matters require various changes, so that a reference like that suggested seems desirable.

The second suggestion (and this would be included in the first) is that we need more frequent meetings. Our annual and fall meetings have become a settled custom, but it seems as if it would be advantageous to have at least two others, making our meetings quarterly. Perhaps not all of us could attend each time, but the benefit to those who could, would redound to the good of all. The interest would be stronger and our acquaintance better, and this leads to the third point.

When we get together, each one should feel willing to talk to the extent of telling his own experience, or giving such information as he may be possessed of. "But," says some one, "I cannot talk in public. I know about these matters but I cannot speak about them." Well now I beg leave to say, you can. You are among friends, as I have just said, you need to get acquainted and so well acquainted that you will speak or talk before the Association as you would in your own office or in your own house.

Oh, but it doesn't sound right. I can't express myself clearly. Well, my dear brother, we are here to learn; if we wanted oratory we would call in a clergyman, lawyer, or a professional talker, but what do you suppose they could tell us about hydraulics? How many of these gentlemen could shut a hydrant turning to the right to open? Or how would they succeed in performing any of the daily operations required on water-works? In short it is water works and not oratory in which we are interested. Our meetings should partake of the nature of experience meetings. It is facts, not words, that make up the sum total of our knowledge.

In the topics coming up for discussion at this meeting you are all interested; if you will each give the result of your own experience so as to impress upon those who are doing our work in a faulty or inferior way, the necessity of doing it rightly, you will have accomplished enough to fully justify us in leaving our work and meeting together in council. In this way only can we secure our own growth, leaving to others, to formulate in words better than we can, the results of our observations and study.

The first paper read was upon "The Weight for Cast-iron Pipe for all Sizes and Pressures as deduced from pipe in service," by A. F. Noyes City Engineer of Newton, Mass. Mr. Noyes concluded from his own experience that the pipe in general use was heavier than called for by the conditions of the case. A lively discussion followed from Messrs. Chase, Howland, Joy, Darling, Sherman, Parker, Billings, Holden and others.

Mr. W. R. Billings, of Taunton, Mass., read a paper on "The Necessity of Tanks to supply Water-closets and Hot-water boilers," and strongly advocated their use both from a sanitary and an economical point of view. He believed that by the tank the consumption of water could be reduced from 60 to 3 gallons per day in addition to the more thorough cleaning. This paper was also discussed, but all seemed to agree with the speaker.

In the afternoon a committee, made up of W. B. Sherman, A. F. Noyes and A. H. Howland, was appointed to conduct a series of experiments to ascertain the proper weight of cast-iron pipe. Another committee, consisting of Edwin Darling, A. S. Glover and T. E. Hall, was appointed by the chair to revise the constitution.

At the evening session the following board of officers for the coming year was proposed by the committee appointed for that purpose and duly elected:

President, R. P. C. Coggeshall of New Bedford; Vice-presidents, W. B. Sherman of Providence, R. I., W. R. Billings of Taunton, S. E. Granniss of New Haven, Ct., and F. H. Parker of Burlington, Vt.; Secretary, A. S.

Glover of Newton: Treasurer, Edwin Darling of Pawtucket, R. I.; Executive committee, George A. Ellis of Springfield, W. H. Richards of New London, Ct., and J. E. Hall of Quincy; Finance committee, G. E. Batchelder of Worcester, N. I. Jordan of Auburn, W. H. Harding of Cambridge.

Mr. G. H. Brown, superintendent of the Mystic division of the Boston Water-works read a paper on "The Necessity and Method of Flushing Street-mains," and declared himself in favor of a frequent and thorough flushing. A dozen other members expressed themselves of like mind, though some others thought once a year was enough. Miscellaneous matters were then discussed relating to the best packing for water-gates and the depth of leaded joints. Italian hemp was generally regarded as the best packing, and Mr. Stacy suggested impregnating it with plumbago to make it more durable; but why the depth of lead joints should vary from 1¾ to 2¾ inches was left an unsettled question.

The proceedings of June 19, opened by the reading of a paper by Frank E. Hall, of Quincy, on "Street-mains," in which he discussed the varied merits of wood, cast-iron, cement-lined and wrought-iron pipe. He thought that cement-lined pipe properly made and laid formed an excellent water conductor. The experience of others followed this paper. The report of Messrs. Coggeshall and Billings on "Uniformity in the Preparation of Water-works reports," is given in full in another part of this issue. A. H. Howland, J. H. Hathaway, A. G. Glover were appointed a committee to recommend a uniform classification of rates at the next meeting.

Immediately after adjournment Chief Engineer Leshure conducted a series of experiments on Pychon street, to illustrate the friction in fire hose reported as follows: With 50 feet of hose, ¾-inch nozzle, with the pressure at the hydrant at 100 pounds, the pressure at the nozzle was 93 pounds. With a ¾-inch nozzle with the hydrant pressure at 100 pounds it was 60 pounds. Other experiments through 300 feet of linen rubber lined hose gave these results: One and one-fourth inch smooth nozzle, hydrant 90 pounds, nozzle 32 pounds; 1¼-inch ring nozzle, hydrant 90 pounds, nozzle 42½ pounds; 1¼-inch smooth nozzle, hydrant 90 pounds, nozzle 42½ pounds; 1½-inch smooth nozzle, hydrant 90 pounds, nozzle 20 pounds; 1½-inch ring nozzle hydrant 90 pounds, nozzle 26 pounds; two lines of hose, 300 feet each, running into one 1½-inch smooth nozzle; hydrant 90 pounds, nozzle 42½ pounds, three lines of 300 feet of hose into one 1¼-inch smooth nozzle; hydrant 90 pounds, nozzle 60 pounds. With three lines of hose and a one inch smooth shut-off nozzle with the pressure at the hydrant at 90 pounds, the pressure at the nozzle was 81 pounds, and this was forced up a 135 pounds, and with one line of hose the nozzle pressure of 60 pounds was forced up to 160 pounds.

A complimentary dinner was given to the Association by the citizens of Springfield, at the Massasoit House, at which about 70 persons were present and numerous speeches made. At 2 P. M., the members visited the Chapman Valve Works at Indian Orchard as the guests of the company. In the evening the "Flushing of Street-mains" was discussed along with other matter of interest professionally.

PERSONAL.

JAS. MALONEY has been appointed Inspector of Masonry on the new Croton Aqueduct.

MR. J. A. EACUTT, formerly of the Louisville and Nashville, has been appointed Superintendent of the third division of the Mexican Central Railroad at Mexico, Vice Wm. Davis resigned.

CHAUNCEY M. DEPEW, the well known attorney for the New York Central R. R., was elected President of that great corporation on the 17th. His election will make very little, if any change in the administration of the company's affairs.

MR. B. M. WHITNEY, formerly of the Chicago & Alton R. R., has been elected City Engineer, and MR. HENRY A. WISE, formerly Chief Engineer of the Missouri Valley Bridge Co., of Leavenworth has been elected Assistant City Engineer, of Kansas City, Mo.

The B. & O. R. R.

PHILADE PHIA, June 23.—The Philadelphia *Times* to-morrow will print an interesting interview with Chief Engineer Douglass, of the Baltimore and Ohio Railroad Company, regarding the building of that company's line through this city to make a connection with the Reading system and to get a through route to New York. Among other things Col. Douglass said: "The length of time it will take to build the bridge across the Schuylkill in case the ordinance granting us permission is passed will depend on the luck we have with our foundations. I think we can build the bridge in four months. Two-hundred carpenters and calkers will be put to work first to build the caissons. The building of the caissons will consume several millions of feet of lumber. Four hundred stone-cutters and masons and 400 laborers will be put to work on the piers besides, and when the iron work is put up between 1,500 and 2,000 men will be employed, making about 3,000 men that will be at work on the bridge before its completion besides the painters.

"While these men are at work on the bridge we will have fully 1,000 more stonecutters and masons at work on the road from Gray's Ferry road to Pennsylvania avenue, and about 1,800 laborers. The proposed tunnel will be 1,743 feet long. From the top of the road to the line of the intrados of the arch at the center will be 20 feet, and the width of the tunnel at the base 26 feet, while at the springing line of the arch the tunnel will be 28 feet wide. The tunnel will cost $100 per foot, or $174,300. The arch will be of brick, and the sides of stone. It will take about 1,400,000 bricks for the arch. The tunnel will cost twice as much per foot as the elevated road we proposed would have cost, but in the aggregate the tunnel will not cost as much because it will not be near so long as the elevated road would have been."

It has been estimated by the officers of the Baltimore and Ohio Company that the cost of construction and the right of way of the road through the city will be $7,000,000. The cost has been figured so closely that there will not be a difference of $500,000 either way. When asked about the depots of the new road in the city Col. Douglass said that the passenger station would be located at Twenty-fourth and Chestnut streets, and that eventually the company would require all the ground from Twenty-third-street to the line of the road, and from Chestnut to Walnut street for station purposes. "We will have a dozen freight stations," continued Col. Douglass, "in different parts of the city, and the one that will be the most convenient for shippers in the central part of the city will probably be at Thirty-first-street and Sutherland-avenue. I hope we can go to work by the first of July. If we can we will have the road built and will run passenger trains from Baltimore to New York on the 1st day of January. We will run from our depot at Twenty-first and Chestnut streets to New York in two hours. Within a day or two after we get permission to build the road we will put 5,000 men to work on the route within the city limits."

The road when finished, it is estimated by the officers of the company, will give permanent employment to about 1,000 men in this city in the capacity of agents, clerks, brakemen, conductors, and other classes of railroad employes. There will be a special meeting of Select Council to-morrow afternoon for the purpose of discussing the ordinances which were favorably reported by the Railroad Committee last week.

The R. P. I. Commencement.

The Fifty-ninth Annual Commencement exercises of the Rensselaer Polytechnic Institute at Troy, N. Y., took place on the evening of the 17th. Thirty young men were graduated as Civil Engineers. The following is the address to the graduates:

Gentlemen of the Graduating Class:

You enter the profession at a time of great industrial and business depression, which is very discouraging to the aspirant after engineering honors and fame. You are fortunate, however, in entering active life from a school whose diploma is universally regarded as a passport to employment, and there is usually some niche where a Rensselaer man can get a footing.

Whatever branch of engineering either one of you may take up as a specialty, bear in mind that you have much to learn, that engineering is as much a science of observation and practice as it is of theory, and he is the best engineer who so harmonizes theory and practice as to let neither overbalance the other. Do not make haste to get ahead too fast, and be content to begin humbly near the bottom of the ladder. No matter how well equipped you may imagine yourselves to be, rest assured the personal experience through the lower grades of the profession is of infinite value in training the judgment and observation, and in giving that acquaintance with the practical conduct of affairs that no school in the world can do. Yours is a profession brought into peculiar relations to capital and labor, and all questions relating thereto should receive your most earnest consideration. You must secure and maintain the confidence of both, which can only be done through perfect integrity of character and a high-minded sense of justice. Ever do what is fair and just between employer and employed, and guard yourselves against any influences that would seek to make you fill the role of attorney for either side. In your estimates deceive neither yourselves nor your employer, but rather incline to over, than underestimating. The engineer whose reputation is established for not making misleading estimates, has the confidence of capital, and is always sought out when there is work to be performed. You should lose no opportunity of gleaning information from the wage workers, with whom you will have to deal—depend upon it, there are many such at whose feet you can humbly sit, and learn how men and materials are handled. In conclusion, permit me to extend the congratulations of an old alumnus at your having reached the goal of your first ambition, which we are celebrating here to-night, and to welcome you to the ranks of the active profession of the civil engineer. You go forth to your chosen field of work under the aupices of an alma mater of whom you may well be proud, and whose influence and reputation is in your hands to still further extend. See to it that no act of yours sullies her honorable past, and may the pages of history you contribute to her record of graduates be full of deeds accomplished and multiplied honors.

The speaker of the evening was Alfred P. Boller, A. M., C. E., of New York City. He received the degree of Master of Arts at the University of Pennsylvania 1858, and graduated from the Rensselaer Polytechnic Institute with the class of '61. After an introduction by Judge Forsyth he spoke as follows:

Ladies and Gentlemen:—

We are assembled here this evening, in conformity with the time honored custom of bidding a God-speed to the yearly graduates of the oldest scientific school in America, a school that has performed no insignificant part in its contribution to the development of the material resources of this country, and which has made a name for itself in the scientific world for the thoroughness of its training and the conscientious care exercised in seeing that its diploma is no unmeaning testimonial. The occasion is one, therefore, that is peculiarly appropriate for a glance at a few of those tendencies of the times, which the scientific spirit has done so much to bring about, and which has yet an important part to play in shaping their development.

It has been well said that each generation is the "Heir of all the ages," and the legacy so bequeathed to the rising generation, is an inheritance of such surpassing richness, that the burdens and responsibilities involved in its proper use and distribution, are well nigh appalling. Every human accomplishment is the sum of all past experience in the same direction, and not only becomes the stepping stone for still greater achievements, but opens up new vistas of truth and possibilities which invite hosts of active explorers. No matter what is attained, there is always a something beyond ever luring mankind on to greater endeavor, in an effort to attain an ideal perfection, or to penetrate those mysteries of nature which surround us on every

side. Since the well nigh universal acceptance of the great generalization of modern times, the law of Evolution, all history and human achievement possess a peculiar significance and interest hitherto entirely overlooked. It is seen that apparently fitful or spasmodic movements of events or accomplishments are in pursuance of a great undercurrent of law and order, to which society is as obedient as inanimate nature, and which must be weighed not by themselves or the span of a generation, but by all their complex bearings or relations to each other, unbounded by limitations of time.

In the arts and sciences, it is difficult to realize the insignificant origin of most of our modern achievements, or the successive stages through which they have passed leading up to such wondrous results. The modern steamship that crosses the ocean with the regularity of a ferry boat plying between the shores of the new and old world, making its three thousand miles in a week's time, was in the germ, the day the expansive energy of steam was first noticed. Fulton little dreamed of what his steamboat portended for the future, as she ploughed the Hudson for the first time, nor did Stephenson realize, when he coursed over the Liverpool & Manchester Railroad on the foot, board of the Rocket, that he was preparing the way for a "Chicago Limited, through in twenty-four hours." The bewildering applications of electricity to the needs and comforts of our modern life, traces back to the humble origin of a piece of amber and a frog's hind leg.

We look with awe and admiration at those stately structures that span our rivers, making unbroken communication across a continent, and hardly pause to realize they are but the outgrowth of the successive experiences of all past ages, from the time the first rude plank or twisted vine was thrown across a stream. There is a striking difference between the methods of progress in the past and those of recent times which consists in the fact that the methods of the former were almost wholly empirical, while those of the latter have combined with empiricism a knowledge of nature's laws and mode of working. This difference has been so vast, as to have wrought a complete revolution in modern society, lending a boldness to enterprise that the certainty of attaining a preconceived result alone could justify. The early users of steam, ignorant of the laws that governed its action, or the strength of materials for its utilization, could not possibly see beyond the effort of the moment, and only advanced step by step through the success or failure of experiment.

The modern engineer equipped with the full knowledge of the laws governing gases and heat, and with the strength and possibilities of the materials of construction, sets to work to produce a result in conformity with predetermined requirements. If a steamship is required of a certain speed, draught of water, cargo capacity or consumption of fuel, of wood, iron or steel, it will be produced with unerring certainty. A locomotive to haul a given load, over a given grade, at a given rate of speed, is not a matter of trial, but of exact design and manufacture. A bridge is no longer a process of experimenting upon various combinations of wood, iron or steel, guided by a sort of mechanical instinct, but a matter of exact proportioning of the different parts to meet the various forces that are called into action by the weights to be sustained, regulated by the known capacity of constructive material and the limits of workshop possibilities. The limiting span of a given kind of bridge, is not a matter of guesswork, but one of exact figures, which no future discovery or experience can ever change. The metals of construction can be produced in as large masses and fabricated into shape, as can ever possibly be wanted in the boldest engineering enterprise, any improvements to be made being in the direction of detail and cheapening processes.

Electricity, the most subtle force in nature, is probably as well understood as it ever will be so far as the laws which govern its mode of action are concerned, the marvellous developement in its applications to purposes of utility, comfort or luxury in the last few years being purely matters of mechanism. It would seem that science in certain ways, has stamped the limitations of human knowledge, and has established such laws relating to material matters at least, that all future effort can only be in the direction of more perfect methods in their application to human needs, or what may be called the developement of detail. Great enterprises are not questions of engineering as much as of finance. Engineering can foretell with absolute knowledge what can and what cannot be done, on which capital can base its operations. The time has gone by when engineering failures can be laid at the door of an imperfect art, but must be placed on the individual shoulders of ignorance or carelessness.

It is hardly conceivable that we will ever know of what those primary forces in nature consists, which we call light, heat, electricity or gravity, any more than we will ever know what are mind and spirit. We know them purely by their effects and the laws which govern them, and can apply them to useful ends with a perfect certainty of results. One cannot help thinking, that civilization has reached that stage of developement when no great revolutionary discoveries may be expected, like the printing press, steam engine or the telegraph, and that the world's work of the future will be the sorting and systematizing of its accumulated knowledge, and its better adaptation to human needs and comforts. This implies a great extension of the division of labor that is so characteristic of the times, and an army of specialists in every department of human knowledge.

The specialist of to-day is no longer some one individual, standing out alone among his fellows, with exceptional information upon a given subject, but one of a large class, working up the details in the same field. When one contemplates the achievements of Science, Art, and Literature, and what it now means to a well-informed man, one may well be discouraged with the feebleness of its capacities, and the hopelessness of the task of endeavoring to put a quart in a pint measure. At best despite the most strenuous efforts, we can be but smatterers in general knowledge, utterly ignorant of much, and thoroughly informed in but little, and any worldly success hoped for, must be through the medium of some speciality to which we must consecrate our lives and energies. Growing out of our social system, and brought about by the accumulation of capital made possible by the great wealth-producing power of machinery, is the tendency toward centralization and co-operation. This tendency is as resistless as the tides; and is affecting the social and political systems of the world as well as the interests of corporations and individuals.

In this country it is strongly marked by the consolidation of vast corporate interests, like our railways, which from comparatively isolated ownership, have been linked into a few great systems, until it may be said that less than a dozen corporations control the traffic of a Continent. The whole anthracite industry, its production, sale and transportation is concentrated in the hands of four or five corporations, while the great petroleum business has been gradually absorbed and concentrated until but a single corporation has become its absolute owner. The Western Union Telegraph Company with its 14,000 offices, is practically the single medium through which the telegraphic communications of the nation are conducted. The same tendency is seen in the combination of capital in all the great industries, even to farming operations, cattle raising and shop keeping. Even the religious bodies, always conservative, are not far behind the spirit of the times, and are being drawn together for the mutual strengthening of common interests, in a way that would not have been deemed possible a quarter of a century ago. The combination of the working classes by means of the various powerful trades organizations, is one of the most important social and industrial factors of the day, and responds to that tendency of the times which seeks strength by union.

In the general government, despite the sacredness of the Jeffersonian traditions, or constitutional limitations, there is a general drift towards the paternal idea, and the control of those greater questions which affect the body politic as a whole, called centralization by some, and regulation by others. Congress is repeatedly sending committees over the country, investigating sundry questions relating to labor, transportation or economics, and the people unhesitatingly appeal to the Government, the moment their creations and necessitation have grown beyond control.

There are many thoughtful men, who see no other solution to the endless strife between the great railway systems, than State regulation, to protect invested capital and assure shippers uniformity of rates,—an idea that recently has been strongly advocated by some of the best railway economists of the day. The Government control of the telegraph system is no new suggestion, and finds strong support from a large body who believe that the transmission of the telegraphic communications of the people should be under the same custodianship as the mails. The issuing by the Government, of bills of exchange, purely a banking business, called postal money orders, is a small thing in itself, but a very important straw indicating how governmental theories give way before the necessities and conveniences of a people.

There are certain tendencies of the times, that are assuming enormous proportions, growing out of the very achievements of our modern civilization on which we are so prone to congratulate ourselves, and pointing to some sort of readjustment between labor and capital, if not of society itself. Machinery, education, and ease of communication, have so changed the social condition and aspirations of mankind, that the study of sociological questions has become of the highest importance. Sociology is essentially a statistical science relating to the complex affairs of human society and is therefor of necessity a science of slow development.

The field to be gleaned is the world, and the statistical work required can only be effectively performed through the machinery of Government. The social, economical and politicial ideas of the past that have thus far guided the industrial development of society, based upon the general law of free competition and survival of the fittest, giving full play to the selfish and grasping instincts, has borne the natural fruit of bitter antagonism and social unrest.

The poor and wage-earning class do not contemplate with equanimity the increasing wealthy and idle classes, while they themselves may be suffering for the necessities of life itself, particularly when they realize that it is upon labor that wealth is founded. They have been trained in democratic ideas ever since the declaration of Independence and the French Revolution, and appreciate full well the absurdity of being at once sovereign and wretched—of being free and equal at the same time bound and inferior. The fault of the past economic notions has grown from the complete elimination of ethical or moral principles, treating men purely as if they were inanimate machines, subject to no other consideration than the law of supply and demand. There has thus grown up an apparent conflict between capital and labor, which we of this generation and those who come after, are in duty bound to conciliate in some way or other, or else look forward to a time when passion and unrest will seek its last resort in revolution.

While it is folly to condemn a system that with all its faults has done such marvellous work in the progress of the human race, and immensely benefitted the average man, it would be still greater folly to sit down calmly to a *laissez faire* policy. Nothing is stationary in nature or society. What may have worked admirably in the past, may be a clog to the present, and so far as man in his mysterious free agency can shape the future, it is his duty to recognize facts and tendencies and be governed accordingly.

The main spring of all human endeavor outside of philanthropy is selfishness, greed or ambition, without which all material progess would come to a stand still. Important as these qualities of character are, if untempered with justice, or unrestrained by law, human or divine, they can but generate the gravest evils. In that one word, justice, must be sought the solution of the great industrial problems justice to capital, justice to labor, justice to humanity. Even if the practice of justice emanates from no higher principle than that of self interest, it will be an immense step forward when it impels capital and labor to recognize that each one is useless without the other, that each have rights which must be respected, that labor should share the profits it helps to create, that disputes be settled by arbitration, and that co-operation is better than unrestrained competition. These ideas are making great progress in the world, and will undoubtedly shape a new system of economics at some distant day.

That phase of sociology embraced by the elastic term of socialism, has, during the last few years taken possession of the minds of men to an incredible extent, and for good or for evil, is bound hereafter to make itself felt in the social and political organizations of society. Probably there is no subject about which there is more popular misconception, than that of socialism, which is commonly associated with barricades, revolution, bloodshed and anarchy of the worst sort. That is certainly one phase of socialism, that may be called the pot-house variety, and is the vicious perversion of a noble aspiration for harmonizing the conflicting elements of society into broader humanitarian relations. Modern socialism evinces itself under different garbs, the common bond of union being a general discontent with the existing social system, and a bitter antagonism against the doctrine of Individualism with the least possible Governmental interference. Speaking of the spread of socialism abroad, Lavaleye says:

"In its scientific garb socialism is transforming political economy and is occupying the greater number of professional chairs in Germany and Italy. Under the form of State socialism, it sits in the council chamber of Sovereigns. Under a Christian form it is making its influence felt in the hearts of the Catholic clergy and still more in the hearts of the ministers of the different Protestant denominations. In its violent form it is taking possession of almost all mining and manufacturing operatives, and at this moment it is beginning to invade the rural districts."

In England the socialistic agitation, is seen in the various movements 'for the naturalization of land, represented by Stewart Mill, Alfred Wallace, and later Henry George. The Christian movement was started by Maurice, Kingsley and Hughes, and is now represented by the Guild of St. Matthew—and the social Democratic Federation which "aims at the complete overthrow of the existing social, economical and political order, and the concentration of hands and all the instruments of production of the country in the hands of a Democratic State." This last, borrowed from the German ideal, does not mean an overthrow by violence, but a gradual change to be slowly brought about in process of time and attained through education and greater intelligence.

In this country the socialistic agitation has not disturbed us much beyond the theory phase of it, represented by the Schabs of a few of the largest cities and the banding together of various labor organizations, not for the purpose of propaganda, however, but for protection and support. Our land system is so different from that of the old countries and there is so much cheap land, that it can hardly become a disturbing element in our social system, as it is in England, at least for a very long time to come. Nevertheless, the drift of the tendencies previously noted are socialistic in character, pointing to a still more intimate relation between the Government and the people, co-operation among the people themselves, and the regulation of corporations. He would be a wise prophet who could forsee the ultimate outcome of the social unrest that

pervades the civilized world at the present day, but to a believer in progress through development, and those mysterious moral forces that conquer passion and enforce justice, the seeming inconsistencies and apparently unsolvable difficulties of the socialistic tendencies of our times are all in pursuance of some hidden laws, which will eventually harmonize in some sort of a social state founded on that which is best in our nature.

Society can delay and obstruct, but cannot arrest the onward march of its natural development, by practising a broad Christian charity, regarding wealth as a trust, and not simply as a means of luxurious living—inculcating respect for law and order, thrift and frugality, and frowning down all waste and intemperance. It remains much with ourselves and our succeeding generation whether the social, economical and political changes which all feel must come sooner or later, shall be shaped through coercion and violence, or decently and in order.

The Alumni Association of the R. P. I. met on the morning of the 17th, and elected the following officers: President. Joseph C. Platt, '66; first vice president, Theodore Voorhees, '69; second vice president, Henry W. Wilson, '64; third vice president, Alfred T. White, '65; secretary, H. B Nason; corresponding secretary, Warren T. Kellogg, '61; treasurer, John Squires, '69; directors, David M. Greene, Elias P. Mann, '72; P. H. Baermann, '67; William P. Mason, '74; E. Ray Thompson, '76.

The Alumni Dinner, was held in the afternoon: 65 members were present and enjoyed themselves after the usual enjoyable style of the veterans of the profession.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 396*).

FARM GATE.

Fig. 94½ is a plan of farm gate, for whether the fence is of boards or wire, it is best to make the gates of wood. The illustration needs no explanation. The cost of labor of such a gate is, carpenter 1½ hours, blacksmith, (hinges and hooks) 2 hours.

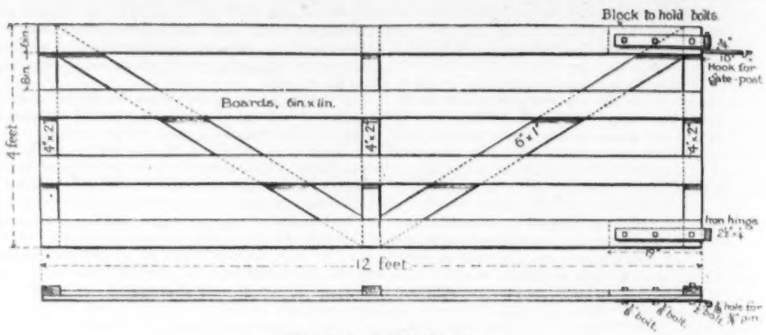

FIG. 94½—FARM GATE.

CATTLE GUARDS.

At road crossings the State law usually requires cattle guards to prevent cattle from straying down the track. Some States leave the style of guard as a matter of selection, as for instance, the statute of the State of New York, which calls for cattle guards "good and sufficient." Where such latitude of choice exists there are several kinds to select from. A good type of the form most generally seen is Fig. 95, the standard of the Penna. R. R. This is an open pit walled up on all sides, the rails being carried by stringers. There are many objections to be raised against this form. In general it is bad practice to lay the rails directly on the stringer, for should a derailed truck be dragged over an open pit, there is great probability of its falling in, resulting perhaps in a serious accident. Secondly, large cattle may get into the pit, in which position they are liable to derail a train. Thirdly, unless the ballast is good, the track on either side heaves, necessitating the bad work of blocking on stringers or the generally difficult work of blocking under them. Fourthly, they soon lose their effectiveness by being filled up, unless constantly cleaned. In order to avoid these difficulties, sometimes bevelled ties, Fig. 96, is laid on the stringer, the full face of the tie being left under the rail while the other parts are triangular with the apex uppermost. This tie meets all the objections but No. 2, and this danger is increased, for, if a large animal should attempt to walk over the ties (and they do,) the almost inevitable result would be the dropping through of its legs and thus the beast be held in a position dangerous to trains. Sometimes instead of having ties the

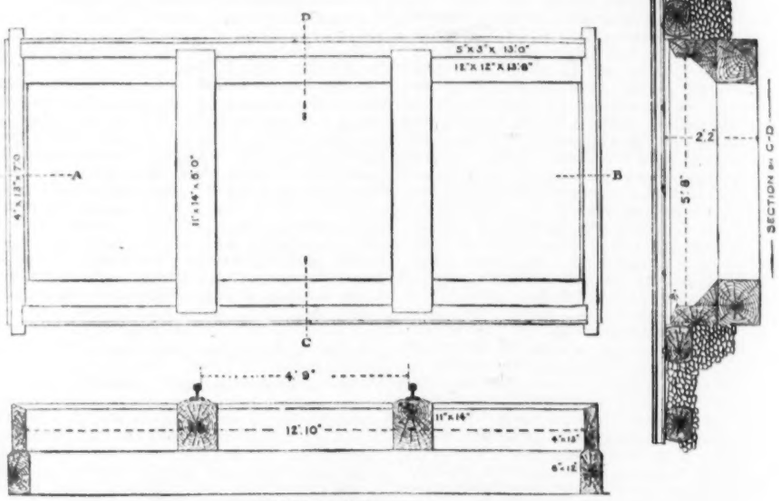

FIG. 95—PENNA. R. R.—STANDARD CATTLE GUARD.

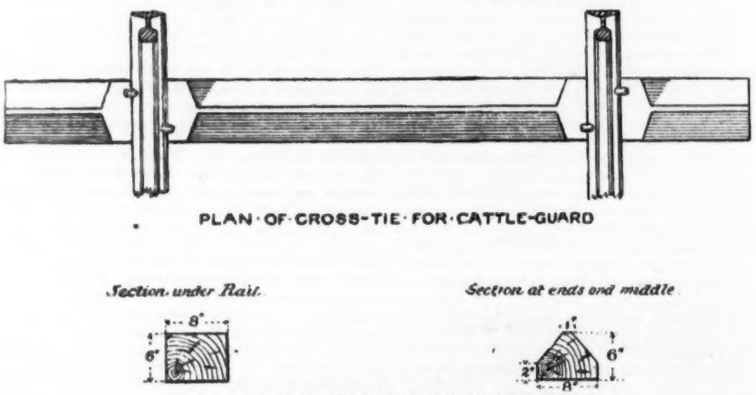

FIG. 96—PLAN OF CROSS-TIE FOR CATTLE GUARD.

rails are laid on stringers, and wedge shaped pieces parallel with them are laid over the whole opening, giving what is known as the "grid-iron" cattle guard. This, however, possesses all the disadvantages and none of the advantages of the bevelled tie. A cattle guard quite as effective as any other to turn stock, one that is perfectly safe and more economical than those described is the "slat" cattle guard as detailed in Fig. 97.† The slats are sawed out and held together by iron rods, being separated by distant pieces of suitable size. Each section can thus be lifted up to permit the regular track work to be performed. Between the tracks two or three ties are put in as stringers, and to them and the regular ties the slats are secured by nails. No especial arrangement of the ties in necessary, except that they should be of even surface, thus sawed ties give the most satisfactory results. Cattle will not walk upon these edges but will jump them if the slats are not too long. In order to form continuous barriers between the cattle guards and the fence, the latter is turned and run down across the right of way along side of the road until it meets the cattle guard of whatever form. The end of the fence should be sloped so as to permit its foot to be placed as close as possible to the rail. The full details of the fence are given in Fig. 97, where it is shown in connection with the slat cattle guard; should the contour of the road bed be such as to leave a large opening under the bottom board over the ditch the space can be stopped by a diagonal board as indicated by the dotted lines on the right hand side of the diagram. These fences and slats should be whitewashed so as to render the road crossing more distinctly visible both to enginemen and teamsters, and as well for the neat effect. It is also possible that a white glaring surface tends to turn stock. The cost and labor of equipping a road crossing with four such fences with the right of way 100 feet wide is 5 men for ½ day.

(TO BE CONTINUED.)

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† Cut shown next week.

CORRESPONDENCE.

Japanese Laborers.

TOKIO, JAPAN, May 19th, 1885.

EDITOR OF ENGINEERING NEWS.—Dear Sir. In your issue of April 11th, your type setter forces me into making a pretty rash statement, viz., that "Japanese laborers may be made to do as much work in a day as do three of any other nation."

If for *three* you will subtitute *those*, the sentence will read as I wrote it. The fault may be to a certain extent my own, as my writing is none of the clearest. If you will kindly insert this correction, you will confer a favor upon Yours Respectfully,

J. A. L. WADDELL.

Fly-wheel vs. Duplex Pumping Engine.

ST. LOUIS, JUNE 22, 1885.

EDITOR ENGINEERING NEWS:—"I am much surprised to see the personal feeling shown by Mr. Hague regarding the paper which I read before the St. Louis Engineers' Club, "on Pumping Machinery for Water-works."

I was well aware of the danger of getting into a newspaper controversy on this subject, when requested to prepare this paper for our Engineers Club, and thought I had made it quite plain, that I did not intend "to tread on the toes of any pumping engine manufacturer."

"To still further prove my position in this matter, I might state, that I sent a copy of the paper in pamphlet form to every water-works in the country using steam power, and enclosed in it a printed slip from which I copy as follows:

"I present to you this copy of my paper on Pumping Machinery for Water-works, with the idea that you may find something of interest in it, and also to bring out a full discussion on the subject of just where we shall draw the line, that a crank and fly-wheel engine shall be used and not a direct acting engine."

As remarked in the paper this is debatable ground among engineers, each style of engine having its friends, and the only way to settle it, is to give the friends of each an opportunity to be heard, and requested them to fill out a blank enclosed giving data from their machinery.

The unexpectedly large number of replies which I have received with complete data, in many cases accompanied by a letter going into the subject in detail, shows the interest taken in the subject, and I have yet to receive the first reply in which there is any personal offense taken, and cannot understand why Mr. Hague should think that an attack was intended upon the Pumping Machinery made by the firm which he represents, when the most friendly relations have existed between the designer of their machinery and myself for years before Mr. Hague became connected with that firm. I have not the time to reply in detail to Mr. Hague's attack, but will do so at some future time.

Yours respectfully,

FRANK H. POND.

Y^e Old Time Apprentice.

BRIDGEPORT, O, STATION, June, 18th, 1885.

DITOR ENGINEERING NEWS.—Enclosed please find a copy of an indenture on record in this (Belmont Co.), which may be of interest to Engineers, if you deem it worthy of publication. Yours truly,

WM. B. HANLON.

This indenture made this second day of November, A. D. 1824, witnesseth that Samuel Elliott aged twelve years ten months and twenty-four days minor son of Joseph Elliott, deceased, hath of his own free will and accord, and with the approbation of his mother, Rachel Elliott, put and bound himself as an apprentice to James C. Moore of Richland Township, Belmont County, Ohio, to learn the art and mistry of a practical surveyor and comb-maker which he the said James C. Moore now useth, and with him the said James C. Moore to live and dwell for the full end and term of eight years, one month and six days from this date or until the said Samuel shall arrive and be of the age of twenty-one years, during all which term the said apprentice, his said master shall faithfully serve in all such lawful business as he shall be put to by his said Master according to the best of his power, wit and ability, and shall honestly and obediently behave himself towards his said Master and orderly towards the family of his said Master, he shall never during said term absent himself from the house of his said Master neither day nor night without his said masters consent, but in all things conduct himself as an apprentice should do.

And the said James C. Moore for the consideration of the premises doth covenant and agree to and with the said mother and son each by themselves respectively and jointly to teach and instruct the said Samuel Elliott or otherwise to cause him to be taught or instructed the art and mistry of a practical surveyor and comb-maker after the best way and manner that he can and that he the said James C. Moore will provide for and allow to the said apprentice good and sufficient boarding, lodging and apparel for summer and winter and all other necessaries fit and proper for an apprentice during the time of his apprenticeship and at the end of said term shall furnish or have furnished to the said Samuel a new Bible and a Sunday suit of clothes exclusive of his common wearing apparel.

In witness whereof the said parties have hereunto interchangeably set their hands and seals the day and year first above written.

Signed Sealed and sealed in the presence of	SAMUEL his × mark ELLIOTT.	{SEAL.}
JOHN THOMPSON. JR.	RACHEL ELLIOTT.	{SEAL.}
AUG'ST M. GROVE	JAMES C. MOORE.	{SEAL.}

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES. M. AM. SOC. C. E.; M. INST. C. E.

(CONTINUED FROM PAGE 381)

DCCLIX, COLUMBIA, CAL.

Columbia, Tuolumme Co., California, in lat. 38° N., long. 120° W. It has never been incorporated. Water-works were built in 1853 by a private company, taking the supply from springs and from Stanislaus River. The water is conveyed to the town in ditches and pipes, and is distributed by 5 miles of cast and wrought-iron pipe, with one fire cistern and 75 taps. There are no fire hydrants in use. Service pipes are of iron and lead. The daily consumption is 30,000 gallons during the summer season.

The works have cost $23,000. There is no bonded debt. The yearly expenses of maintenance are $800, and the receipts $1,200. The population in 1880 was 650. G. Wing is Superintendent.

DCCLX—OURAY, COL.

Ouray, Colorado, in lat. 87° 50' N., long. 108° 30' W., is the county-seat of Ouray Co. Water-works were built in 1881 by the town, taking the supply from Oak Creek. The water is impounded in a reservoir, and is conducted to the town in cast-iron pipes. Distribution is by 3 miles of cast-iron pipe, with nine fire-hydrants and 350 taps. Service pipes are of wrought-iron. No meters are used. The works have cost $22,500. The bonded debt is $20,000 at 8 per cent. The yearly expenses of maintenance are $1,200, and the receipts $3,500. The population in 1880 was 864. No further information can be obtained.

DCCLXI. PENN YAN, NEW YORK.

Penn Yan, New York, in lat. 42° 40' N., long. 77° 10 W., the county-seat of Yates Co., is at the foot of Lake Keuka in a fine agricultural and fruit-growing region. It is also a manufacturing town of some importance.

Settled in 1814 it was incorporated a village in 1833. Water-works were built in 1884 by a private company after plans of Hinds, Moffett & Co., taking the supply from the lake which is 22 miles in length and from half a mile to one mile wide. The water is pumped from the lake by a Worthington compound duplex pump of 12 and 17 inch steam and 10 inch water cylinders and 15 inch stroke, having a capacity of 1,000,000 gallons daily, lifting 115 feet to a plate iron tank 25 feet in diameter and 60 feet high, holding 220,893 gallons. Distribution is by 5½ miles of cast-iron pipe of 12 to 4 inch diameter, with 40 fire hydrants. The works have cost $70,000, which is the amount of the bonded debt at 6 per cent. F. B Merrill is President and Treasurer, and Frank W. Allen, Secretary.

DCCLXII—PULLMAN, ILL.

Pullman, Cook Co., Illinois, is in lat. 41° 50' N., long. 78° 35' W. The town was built and is owned by the Pullman Palace Car Company for the accommodation of the large force of employees working in their shops.

Water-works were built in 1881—2 by the Company, taking the supply from the works of the village of Hyde Park, Ill., which have been previously described (ENGINEERING NEWS, Aug. 18, 1883, p. 388.) The water is pumped through six miles of cast-iron pipes from Hyde Park to an iron tank 56 feet in diameter and 30 feet high, holding 500,000 gallons. The base of the tank is 130 feet above the general ground level. Distribution is by 15 miles of cast-iron pipe of 18 to six inches diameter, with 150 fire-hydrants, 100 meters and 754 taps. Lead pipe is used principally for services; there are also a few wrought-iron pipes in use. The Company pays $25 per million gallons consumed. The daily consumption in 1882 is said to have been 560,000 gallons. In 1884, 85 gallons per capita were used daily in the dwelling houses, and 230,000 gallons in the shops.

The cost of the works, including part of the force main, has been $250,000. The company has no water debt. The yearly expenses of maintenance are not separated from those of Hyde Park, and cannot be given. The revenue in 1884 was $27,000. D. Doty manages the works for the company.

WATER.

VINCENNES, IND., is thinking of building water-works.

ASPEN, Colo. proposes to issue $40,000 in bonds to build water-works.

THE Massachusetts House bill authorizing cities and towns to establish water rates and to sell water for manufacturing purposes at reduced rates was passed at Boston, June 16.

ORLANDO, FLA., will vote July 25th on the question of issuing $50,000 in bonds for erecting water-works and establishing a system of drainage.

ATTENTION of contractors is called to the construction of a large reservoir at Cohoes, advertised elsewhere this week; also to the furnishing of pipe, valves, gates, etc., and to the work of laying and setting. July 6th is the last day for receiving bids.

THE water works constructed, at Eau-Claire, Wis., by the D. Shaw Lumber Company a few years ago have been negotiated for by the company engaged in putting in the present system for the city, and the supply for fire and sprinkling purposes will shortly be ready for operation.

A PURER water supply and drainage system were introduced into Calcutta in 1870, and during the next three years the cholera mortality fell off from 3410 to 1075 per annum. Since 1876, however, it has steadily increased, although the water supply is still in fair condition and the drainage as good as in many European cities. It often rises to 800 deaths per month during the summer season, and in March of the present year it was 568.

LARGE CONTRACT FOR WATER PIPES.—Tenders have lately been taken by the Cardiff Corporation for the supply of 22,500 tons of cast-iron pipes for the new water-works scheme of that town, and it is reported in Glasgow that the offer of Messrs. Thomas Edington and Sons, of the Phœnix Iron Works, in conjunction with Messrs. D. Y. Stewart and Co., both of that city, has been practically, though not formally, accepted. The next offer was that of a Dudley firm of pipe founders. The pipes range in diameter up to 29 inches which is a very odd size. As might naturally be expected, much satisfaction is felt locally at the success of the two firms named.

THE Water Tower at Lexington, Mo., collapsed on the 22nd inst. It stood on the highest elevation in the city, was composed of six iron columns, 50 feet in height upon which stood the tower or tank, 152 feet high, 22 feet in diameter, with capacity of 365,000 gallons of water; and full to overflowing at the time of bursting. The iron in the tank was half inch in thickness; the columns solid cast-iron, 40 inches diameter, Not a pillar was left standing. Some of them were carried to the foot of the hill. The tank was scattered in all directions, as though the wreck was caused by an explosion. Some twenty minutes before it fell Mr. Simmons under whose supervision the water-works were constructed, had climbed to the top of the tower. Mr. Simmons was seen, but he was too greatly worried to talk and cannot yet advance any theory as to the cause of the wreck. The water-works have not as yet been tested or accepted by the city, though for some weeks the city had been supplied With water.—St. Louis *Globe Democrat*.

UNDER the recent action of the Council Bluffs, Ia., council, the city engineer is to keep the city sewers flushed out, and as often as he deems it necessary he can call to his help in this work the fire department, the firemen to be paid for their time at the usual rates, except those working by the month.

G. W. PEARSONS, of Kansas City, Mo., is building Water-works at Marshall, Mo., for Marshall Water-works Co.; 4¼ miles of mains ranging from 10" to 4"—direct pressure, two Worthington pumps; one single the other compoundr 65 hydrants;—source of supply, a well 36 feet in diameter will be 40 feet deep, sunk through a water bearing gravel, 20 feet in depth; will make a good supply of excellent water, to be in operation in September.

TWENTY-SIX miles of water pipe are to be laid by the St. Paul water commissioners this year—that is, three miles on Dayton's bluff, five in the valley portion of the city, and from sixteen to eighteen miles on St. Anthony hill.

The record for the year will approximate very near to these figures:

26 miles street mains, 3,035,640-2000 tons	$100,165.56
Specials 84	5,460.00
225 fire hydrants (Matthews)	13,500.00
Gates and boxes	6,251.00
Lead, 54 tons, hemp packing	4,500.00
Excavation and laying	38,700.00
Extra for rock excavation	10,000.00
Draying, 3,500 tons	2,625.00
Total	$181,201.66

The work is pushed as rapidly as possible, especially on the light service. The superintendent of the works is employing 350 men, all of the pipe is contracted for from St. Louis, and the delivery is fairly rapid. Where the St. Paul & Northern Pacific line crosses the mains, on Mississippi street, a large contract, paid for by the railroad company, is under way, consisting in lowering the thirty-inch mains over three feet below the grade. On many of the contracts over 800 feet of pipe are being laid per day, while, to complete the entire work this year, 1,500 feet laid must be the daily average. There has been no hitch yet, and the expectation is that none will occur.

THE bottomless swamp that the New York, Pennsylvania & Ohio Railway has had so much difficulty in filling is not much more of an obstacle to engineering progress than the swamp through which the Jamestown, N. Y., Water Company has been laying a main to reach Chautaugua lake. The distance is about two miles, and is divided about equally, one-half the way being black, bottomless muck, the other being sand and quicksand. Frequently a trench would be dug and the pipe laid and pinned down by heavy timbers. Thus it would be left at night, but in the morning the pipe would be found on the outside of the trench, which would be nearly closed up by the shifting of the soil. At times it has been necessary to excavate no small part of an acre to reach the desired depth. All the time the workmen have stood deep in water and mire. Stumps, logs and trees have constantly offered opposition to progress, necessitating cutting down or undermining. It is expected that the line will be completed by the 1st of July, and that, thereafter, the pure waters of the lake will be supplied consumers in this village.

MEASURING WATER.—Very few people in Atlanta know it, but nevertheless the water consumers of the city are just now engaged in the pleasant pastime of investing about thirty thousand dollars in water meters.

There are nearly two thousand water consumers, and the meters cost sixteen dollars apiece. Eight hundred consumers have already invested in the little measuring machines, and over a thousand people are yet to put them in.

There is quite a division of sentiment on the meter question, and a man who has dealt in meters all his life tells a *Constitution* reporter that they will soon become absolutely worthless. He says that in a clear water they will do well enough, but in a muddy water like that with which Atlanta is blessed, they very soon become clogged up with mud, and that the registration amounts to little short of guess work.

The effect of putting water meters on in Atlanta has been wonderful. A few months ago the water pressure was only twenty pounds, whereas now the pressure is never below forty, and often runs to sixty, usually standing at forty-five or fifty.

Some of the meters have been showing very small consumption of water. Several houses have used only five cents worth of water a month, and one man's bill was six cents for three months. Another used so little water that his pipes became clogged, and it cost him seven dollars to repair the damage. Under the old plan the lowest price at which water could be obtained was ten dollars and the city council on the recommendation of the board of health will require a man to use at least eighty-five cents worth of water per month. This will be about as much water as a man will need ordinarily, and will foot up about ten dollars a year. A man ought to use that much water, and if he needs any more he will pay accordingly. The East Tennessee road is the biggest water consumer in the city, and pays from two hundred and fifty to three hundred dollars a month. The Kimball's bill is about a hundred and fifty.—*Atlanta, Ga., Constitution.*

THE Lake City, Fla., water-works were put into successful operation on the 18th.

THE City Council of Chippewa Falls, Wis., have voted to give a franchise to J. F. Moffett and Frank A. Hines, of Watertown, N. Y., and H. W. Phelps and E. G. Ferris, of Minneapolis, Minn., to construct Water-Works for the city. The works are to be built after plans made by E. G. Ferris, C. E. The general outline is to take water from springs running out of the sand bluff about ten miles from the city. The springs come out near the surface of the river, where a sharp bend of the river admits of running a bank across so as to form a reservoir. To be pumped to a tank 100 feet high, 25 feet diameter on high ground, about 80 feet above the business portion, and 15 feet to 40 feet above the rest of the town. To be used by gravity or direct pressure. There will be nine miles of pipes 12x6 inches diameter. One hundred hydrants at an annual rental of fifty-five dollars each. Works to be completed in December. The water is very fine. Contains about 1 gr. each of silica calcium and magnesium and ⅛ gr. of clo-sodium No organic matter. As the springs drain three or four square miles of sand plain about one hundred feet above their outlet with no surface outlet, the quantity seems guaranteed for a population of 10,000.

THE annual report of the Cleveland, O. Water-works department for 1884, has been issued in pamphlet form. It contains the following statement:

Receipts for water, less amount paid for tapping and returned water rent	$296,392.60
Receipts from sale of bonds	350,000.00
Balance on hand January 1, 1884	3,780.81
Total receipts	$650,173.41
Disbursed for running expenseses and additions to service	$638,598.74
Balance on hand January 1, 1885	11,574.67
	$650,173.41
Net earnings of 1884	$220,725.71
Net earnings of 1883	201,403.33
Increase	$19,322.38

During 1884, 28,206 feet, or five miles and 1,806 feet of main pipe was laid of the following diameter: 36-inch, 5,032 feet; 30-inch, 14,992 feet; 24-inch, 3,955 feet; 20-inch, 2,765 feet; 16-inch 1,462 feet. Fifteen miles, 1,411 feet of distributing pipe was laid during the same time, making 175 miles 2,223 feet now in use. Of

THE WASTEFULNESS OF CONSUMERS

Superintendent Whitelaw speaks as follows: "The waste of water during freezing weather and its lavish use on lawns and for cooling premises during the summer months has become so excessive as to call for the adoption of vigorous measures for its suppression. The average consumption of water per day last year was 16,367,153 gallons. The daily average for the month of January was 20,324,373 gallons, while that for the month of April following was only 13,598,832 gallons.

The average daily consumption for the two spring months, April and May, and the two autumn months, October and November, was but 14,011,437 gallons, while the average consumption for the remaining eight months was 17,534,073 gallons per day. The quantity used in the month of April includes a wastage of probably not less than 3,500,000 gallons per day, while for the month of January one half of all the water pumped was wantonly allowed to

FLOW BACK TO THE LAKE.

without having served any useful purpose. If this wastefulness is permitted to go on unchecked the people of Cleveland must be prepared for another expenditure of not less than one million dollars for a larger tunnel, more machinery, and long lines of main pipes within the next five years, for, before the end of the year 1889, at the present rate of increase, which, for the past two years has exceeded 15 per cent. per annum, the full capacity of the tunnel will have been reached, and every engine at the pumping works will be crowded to its utmost capacity, with no reserve in case of accidents. The average consumption per capita (exclusive of the Eighteenth ward, where no water pipe is yet laid) for the year 1883 was 75.60 gallons per day, and 82.66 gallons in 1884."

The Superintendent advocates the adoption of the meter system and a rigid inspection of premises to prevent wastefulness.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

Fort Smith and New Orleans.—Charter filed at Austin, Tex., on the 13th.

Covington and Macon R. R.—Chartered on the 18th L. F. Livingston, President.

New Road.—It is said work will soon be commenced on the new railroad running out of Fayetteville, Ark.

Chattanooga Western R. R.—Sufficient capital has been secured to complete this road to top of Walden's Ridge.

The South Park Railway, Col., have a large force of men shoveling snow in the Alpine tunnel, and hope to have the road open to Pitkin the latter part of this week.

Contracts for grading and bridging 125 miles of the Northwestern road from White river west has been let to Sioux City parties.

South Penna. Contracts.—The contracts for grading that portion of the South Pennsylvania railroad between Harrisburg and the tunnels, will be awarded this month.

Wisconsin Central.—A survey for the extension of the Wisconsin Central railroad from Abbotsford to Merrill is being made, and the prospects are that it will be built before another season of snow.

French Aid Invoked by China.—Li Hung Chang, prime minister, has informed M. Patenotre, the French minister, that China will look to France for aid in the construction of railways and other public works.

Heavy Rock Blasting.—In constructing the big Cascade tunnel at Stampede Pass, Or., it will be necessary to pierce a solid basalt wall for the entire distance of 9,050 feet.

Ulster & Delaware R. R.—Surveyors are at work on the proposed line of the Ulster & Delaware Railroad, between Stamford and Oneonta, the other connecting with Cooperstown Road near the "Hemlocks." The road will run thro' the town of Harpersfield.

R. R. Contract.—ROME, GA., June 20th.—Negotiations are pending with one of the strongest railroad contracting firms in the south, for the building of the Rome & Chattanooga railroad, and it is quite likely the contract will soon be awarded.

Grand Island & Marysville R. R.—Articles of incorporation have been filed with the county clerk of Hall county for the Grand Island & Marysville railroad, with a capital stock of $15,000,000. This is virtually the reorganization of the St. Joe & Western under the new management.

First electric railroad in the United States run on a commercial basis is the two and a half mile line just equipped by the Daft company, between Baltimore and Hampton. The Edison-Field company is nearly ready to start its motors on the Second avenue L road in New York.

The Chicago & Northwestern railway has extended its present track sixty-six miles west of Valentine, Nebraska, and has the route surveyed 150 miles further west, to the borders of Wyoming. It is said to be the purpose of this company to eventually build to Ogden, Utah, and make a competing line with the Union Pacific.

Railway Matters in the Dominion.—OTTAWA, ONT., June 21st.—In the House of Commons last night the Pacific Railway resolutions passed through the committee with some slight amendments. The term fixed for bonds to run is now made fifty years. In the original resolution it was unlimited.

Florida R. R.—There is the usual endless grinding out of Florida railroad charters, and more "talk of building, etc," that any half dozen ordinary newspapers could keep up with. It would seem as if the Florida swamps were by this time pretty well "grid-ironed" by projected railroads.

Chicago, St. Louis and Nashville R. R.—The location of this line is being pushed as rapidly as possible. G. N. Merrill Chief Engineer, has several parties in the field. It is expected to complete the road from East St. Louis to Metropolis, Ill., by Oct. 15th. The entire line will be 296 miles long.

The Texarkana and Northwestern. Survey commenced on the 15th. The capital stock, placed at $100,000, has already been subscribed. The following are the incorporators of the road: W. L. Whittaker, Jos. E. Marx, W. Buchanan, A. L. Ghio, Ben Whitaker, B. T. Estes, E. W. Taylor and C. C. Galloway. The road is to be completed and ready to do business by the 1st of October.

Railroad Building in Arkansas.—LITTLE ROCK, ARK. June, 22.—Railroad building has been resumed in this State, and the indications are that considerable more territory in North Arkansas will soon be opened. The Iron Mountain Railroad is building a large elevator at Batesville and surveying a line for a railroad from Batesvilles to Tollville, Marion County. The Batesville and Brinkley Railroad Company is also arranging to complete its line from Colone to Newport, on the Iron Mountain Road.

What Branch Lines Have Been and are to the transcontinental lines in the United States, is seen in the facts presented by Mr. Chapleau, in the Canadian Legislature. Out of a total of 16,277 miles, comprising the mileage of the seven different railways in that country working their way from the Atlantic to the Pacific, 6,775 miles are branch lines.

On a total of 1,442,800 tons carried by the Northern Pacific only 67,275 tons were through freight. The Union Pacific had $10,427,540 of local freight against $2,512,507 of through traffic. The Central Pacific carried 944,700,000 pounds of through and 3,886,308,000 pounds of local freight.

The Fargo Southern Railroad will this summer be extended south to Flandreau, Minn., at a cost of about $1,000,000.

Nashville and Knoxville R. R.—Right of way is being secured for the Nashville and Knoxville (Tenn.) Road, and it is stated that work will soon begin. The road commences on the south bank of the Cumberland river, opposite Carthage, passes up the west side of that stream along its valley 15 miles to the mouth of Indian Creek, where it crosses. Thence up Buffalo valley to Cookeville on the Highland rim, and to Standing Stone on the mountain, intersecting the Cincinnati Southern in Morgan county.

Fort Scott and Lincoln Road.—Chartered on the 15th.—The estimated length of the road is 280 miles, and the capital stock is placed at $4 500,000. The directors of the company are A. M. Ayer and J. Fayer, of Urbana, Ill.; Jos. D. Bronson, L. Farnsworth, W. H. Welsh, J. M. Davies and F. L. Wilson, of Fort Scott. The headquarters of the proposed road are to be at Fort Scott.

Cattle King R. R.—H. L. Jackson, formerly division engineer of the Witchita & Western at Witchita, Kas., has organized a corps of engineers, and will at once proceed to make a survey for the Cattle King Railway Company from Dodge City to Englewood, Clarke county, Kas. The new line will be seventy miles in length, and furnish an outlet via Dodge City for more than 100,000 head of cattle from the Indian Territory and Pan-Handle of Texas.

Railroad Contracts.—The Elkhorn line, now graded White River, in Northwestern Nebraska, will in the next few days let a contract for 125 miles west. This takes the end of the grade to the junction of the Sweetwater and North Platte Rivers, in Central Wyoming. From the mouth of the Sweetwater it will be possible to build in one season to Corinne, Utah, where connection is made with the Central Pacific. This is Vanderbilt's line to the Pacific coast.

Minneapolis, Sault Ste. Marie and Atlantic.—A meeting of the directors and stockholders of the Minneapolis, Sault Ste. Marie & Atlantic was held on the 16th., at which it was decided to continue the construction of the road to a point twenty-two miles east of the present eastern terminus. This will bring the line within a short distance of the lake. The directors also decided to increase their holdings and pay in sufficient cash to complete this extension, so that the road would not have to be bonded.

The Palmer and Sullivan Charters.—The press of Matamoros are calling on the Mexican government to force the Palmer and Sullivan folks to comply with their charter, which calls for them to build 100 kilometers a year on the Matamoros and Monterey division, which they have not done, being on Jan. 10th. last, 107 kilometres in arrears, and now 147. They ask President Diaz to make the company build the line or step down. If this is done the company will forfeit their charter for all their roads,—*Times Democrat.*

New Colorado R. R.—D. H. Moffatt, President of the First National Bank, of Denver, and ex-Senator Jerome B. Chaffee are in New York makin arrangements for the building of a railroad between Red Cliff, Colo., the present terminus of one branch of the Denver & Rio Grande, and Aspen, Colo. The road will be forty-five miles long, and for the greater part of the distance will skirt the foothills of that range of the Rockies known as the Continental Divide. Estimates have been made on the work, and the construction of the road will commence at once. Colorado capital will be used.

Atlantic Coast Canal.—Rittenhouse Moore, of Mobile, Ala., an extensive contractor on the river and harbor work throughout the south, has just left St. Augustine, where he has been to close a contract for dredging and cutting the Atlantic Coast canal, Florida. Mr. Moore reports that he has made an investigation into the feasibility of the project, the capital behind it, etc., and is so well pleased that he proposes to take hold in earnest and without delay to aid in opening up this great water route along the east coast of Florida. He will bring his dredges, etc., from the Gulf, and his present contract, when finished, will carry the work to Indian river, beside a contingent contract to be taken up later.—Savannah *News.*

New Road in the Northwest.—ADA, MINN., June 23rd.—The Ada, Grand Forks and Duluth Railroad scheme, about which so much was said a month or two ago, has come up again. The road is now planned to run north of the White Earth Indian Reservation and north of Leech Lake to Duluth, and west straight through the country, crossing the Red River near Caledonia, Dakota, and thence straight west or northwest into Dakota. It is to be called the Duluth, Ada and Northern Dakota Road. Certain St. Paul and Minneapolis capitalists have agreed if the road is surveyed and the right of way procured, that they will furnish the money to build and equip this road from the Red River to a junction with the Duluth and Winnipeg, or the Brainerd and Northwestern east to the reservation.

A number of Fargo capitalists have agreed to take hold of the matter and push the road on the Dakota side. Active work will be begun early next spring on track laying. It is estimated that this road can be built and equipped as far as proposed for $9,000 a mile.

Utah and Wyoming Central Railroad.—Incorporated in Utah and in Wyoming Territory providing for the construction of a broad gauge system; capital $3,500,000.

An African Railway Scheme.—LONDON, June 20.—Cardinal Manning continues to urge the founding of a free river state for the Nile, and the extinction of the African slave trade. He proposes, instead of beginning at Suakim, that a railway start from the southern frontier of Egypt, and first bridge the distance between Stanley Falls and the headwaters of the Nile. The Cardinal, on the authority of Henry M. Stanley, says that £100,000 down, or an assured subscription of £5,000 yearly, would be sufficient to start the scheme.

Railway Frogs.—On the C. I., St. L. & C. system there are 980 frogs, and from 75 to 100 require renewal annually. The company, for three years past, have been manufacturing their own frogs, but after investigation they find that they can purchase them from a manufactory at a saving of 20 per cent. and really get a better frog. They are now testing two of the best patterns of frogs, the Ajax, manufactured at Chicago, and the Emley frog, manufactured at Indianapolis, on the main line, with a view of replacing all their frogs with a uniform pattern as fast as a change in frogs is necessary.

Change of Gauge.—The management of the Queen and Crescent Line contemplate changing the gauges of the Vicksburg and Meridian Division, 140 miles; the New Orleans and North-eastern Division, 196 miles; the Alabama Great Southern Division 295 miles, and the Cincinnati Southern Division, 335 miles, to the standard gauge. The Mobile and Ohio changed its gauge on the 25th.

At a recent meeting of the directory of the Louisvile and Nashville Railroad it was agreed to change the gauge of the entire system, some 1,600 miles, on May 1, next, as it was calculated that all the necessary arrangements for the work could not be completed before that. Until then cars going north and south of the Ohio river over this system will have to be hoisted from the tracks at Louisville and Henderson, Ky., where the wider or narrow gauge tracks, as the case may be, are substituted.

Cost of R. R. Construction.—A subscriber wants to know "what the average cost per mile of the American system of railways was, and the name of the road that cost the most, the inquiry to embrace Europe as well as America." The average cost per mile of the American roads, including construction equipment, and terminal facilities is in round numbers $65,000 per mile; that is, the share capital, bonded and floating debt of all roads gives the average mentioned. But what the first cost was is a very difficult question to answer; in fact, it cannot be answered, as so many of the lines were fed on water from the pr liminary survey down to where the guardianship of a receiver began, which water a gullable public took with considerable relish. But the most difficult and expensive construction on record was that of the St. Gothard Railway. It has a mileage of 113 miles—from Immensee, in Switzerland, to Chiasso, in Italy, and cost upwards of $40,000,000, exclusive of rolling stock and terminals. The whole line of the road is picturesque and in places it is awfully grand It is several thousand feet above the level of the sea, and crosses deep gorges, and clings dizzily to steep mountain sides, and where threatened by avalanches, it creeps away to the very heart of rough-rising hills, whose snow covered crests seem to pierce the very sky. More than one-fifth of the entire line is underground, there being fifty-six tunnels, and many of them are not straight, but actually spiral, accomplishing heavy ascents in short distances.

There are also many lofty viaducts, bridges, and complicated galleries. The total length of the tunneling is twenty-three miles. The main or St. Gothard tunnel is nine and one fourth miles long, while there are several exceeding six thousand feet. The great tunnel is twenty-six feet wide and nineteen high. The boring machines were worked by air compressed by large turbine wheels driven by the rapid rushing water of the River Reuss. The air was carried from the compressors outside of the borers within the tunnel in iron pipes six inches in diameter, and the escaping air served an indispensable purpose in ventilation: 3,500,000 feet of compressed air were daily thus delivered and set free, pushing back and out of the tunnel the bad natural gases, with those set free by the dynamite and thrown off animals and workmen. The usual daily advance was twenty-one feet, working from both ends, and the whole excavation was lined as made with a circular tube of masonry, eighteen to thirty inches thick. The workmen were principally Italians, who worked eight hours a day. The tunnel cost the lives of 310 workmen, and 877 others were more or less injured. The work of construction on the line was begun in 1872, but was suspended at different times. About ten years, however, were spent in actual work. The road is now open and doing business up to its full capacity. The Denver & Rio Grande's route, in Colorado, is the nearest approach in this country to the St. Gothard in gorgeous scenery, but the cost of the latter was almost nothing as compared with the Immensee & Chiasse road.—*Cleveland Herald.*

Contracting.

Pipe Line.—A company has just been chartered at Harrisburg with $100,000 capital to pipe oil from Butler County to Pittsburg, in opposition to the Standard.

Arizona Irrigating Canal.—This canal, to be usep for irrigating purposes only, has been completed the entire length of 41 miles.

Bridge Completed.—The Louisville and Nashville R. R. Bridge over the Ohio river at Henderson, Ky., is completed, and will be opened for traffic July 4th.

Brooklyn & L. I. Cable R. R.—The Surveys of this road are being pushed forward under the Chief Engineership of Mr. Anthony Jones, whose headquarters are at 22 Hanson Place, Brooklyn.

St. Louis Cable Road.—The New Albany, Ky., rail mill is busy in manufacturing the iron-work for the St. Louis cable road. The work will keep them busy thirty days or more.

Sewer Contracts.—Jas. Driscoll of Brookline, has the contract for building 1400 feet 22 × 23 inch brick sewer, and 1200 18 inch pipe sewer; Solomon Sanborn of Boston has the contract for 3500 feet of 8 inch pipe sewer, all in Brookline.

A Big Fill.—The trustees of the Cincinnati Southern Railway received proposals on the 17th, from nine bidders to make nearly 250,000 cubic yards of a fill at its terminus in Cincinnati, O. The highest bid was $211,-191, and the lowest $91,540.

Bridge Scheme.—There is a movement on foot at Cumming, Ga., to build an iron bridge across the Chattahoochee river. E. C. McAfee and J. D. Foster own the franchise. They propose to establish a joint stock company.

The Coast Canal Company, (Fla.,) have staked out their route and cut the brush across the Haulover neck, dividing Indian river from the lagoon, on the intended route of the canal. Contractor Fox has a force of Italians on the ground to cut the land down to water level, preparatory to the operations of the dredges.

Bridge Contract Let.—The town of Hancock, Delaware Co., N. Y., has accepted the proposal of the King Iron Bridge & Manufacturing Co. for bridges across the Delaware River, consisting of 9 spans, two of 180 feet each, two of 154 feet each, three of 120 feet each, one 40 feet, and one 30 feet. Amount of contract, $23,818.30. This company has also just contracted to build three iron bridges for the N. Y. L. E. & W. Railway.

Lumber Contracts.—Officials of the South Pennsylvania Railroad have invited bids for 1,200,000 feet of sawed lumber, ranging in length from fifteen to twenty feet 300,000 feet of which is to be white pine and hemlock, the balance oak; to be delivered at such points along the surveyed line, between Pittsburg and Harrisburg, as needed. The engineers have authorized the statement to be made positively, "that trains will be running on the South Pennsylvania road, between Bedford and Harrisburg, on the 4th of July, 1886."

South Penna. R. R. Tunnels.—The work at the several tunnels along the South Penn rail road is making fair progress. At Sideling Hill in the west end considerable delay has been caused by water in the tunnel. As it was, about seventy-five feet were driven. The average progress for the last ten weeks at Rays Hill has been fifty-three feet per week, at Sideling Hill sixty-five feet, and at Allegheny seventy-five feet—which is the highest average along the line. There remains to be done at Rays Hill 1,480 feet out of 3,480 feet, at Sideling Hill 3,940 out of 6,660, and at Allegheney 2,475 out of 5,900.

Extending Mill Creek Sewer.—The St. Louis Board of Public Improvements, on June 17th, adopted the draft of an ordinance providing for the extension of Mill Creek Sewer, from Cabanne street to Duncan avenue. This work will cost about $94,000. The board finds it advisible just now to push this gigantic sewer as far west as possible, because of the rapid settling up in the western part of the city, and the constantly increasing demand for sewerage on the part of the inhabitants. This sewer it is intended shall eventually receive the water of the River des Peres, which is in itself little more than a foul open sewer. The prospects are that millions of dollars will be expended in the next few years building branch sewers to the Mill Creek Sewer.

R. R. Contract.—A meeting of the stockholders of the Alabama Improvement Company was held at Tuscumbia, Ala., on the 16th, 17th and 18th insts. The most important business transacted was the awarding of the contract to build the railroad which is to connect Sheffield with Birmingham. The distance between the two points is 130 miles. Mr. Harvey, of New York, was awarded the contract, which provides that the first forty-five miles from Sheffield must be completed by the 1st of July, 1886. The road will run through the finest iron, coal and mineral sections to be found in the whole country. Work will be commenced at once. This road, when completed, will give an outlet by way of the Tennessee River at Sheffield to the iron manufacturers at Birmingham.

Street Paving in Oregon.—The streets of Astoria, Oregon, are being macadamized with the ballasts of ships which lighter or take in cargo there, and the local paper speaks prophecy concerning it in this wise: "From the coral strands of India, and from the far off islands of the soft south sea, come in the holds of vessels the foundation of many of Astoria's streets. South American pebbles and Australian dornicks; chunks of Eocene formation from the Feejees, and relics of the Paleozoic period from Hong Kong, are alike mingled in the conglomerate mass thet underlies our thoroughfares. When Oregon's future geologists analyze the component parts of the strata, they shall here find it will puzzle them worse to reconcile the geological formation than the Biblical miracles puzzle Bob Ingersoll."

The Colombo Breakwater.—This great work which has occupied in its construction about twelve years, received the ceremonial finishing touch at the hands of its designer, Sir John Coode, on the 22nd April last. The exposure to which a work of this kind is subjected during the long period required to complete it furnishes a sufficient guarantee that it is fitted to withstand any influence attacking it, and the colony of Ceylon and its engineer may be congratulated on the successful termination of a work likely to contribute so greatly to the progress of the island. The closing ceremony consisted simply in the laying, by Sir John Coode, of the last square of concrete capping; and Mr. Kyle, the resident engineer, whose services have contributed so greatly to a successful issue, has finally reported that "the whole of the work, reclaiming the inner harbor foreshore, including jetties, sheds, etc., has now been completed, and all hands have been withdrawn and the account closed." The total cost incurred from the commencement of the operations in 1873 to their close has been 8,125,438 rupees, or in round figures about £812,500. There appears no reason to hope that for the present the local Government will entertain the carrying out of Sir John Coode's design in its entirety by undertaking the construction of a northern breakwater.

Index to Periodical Literature.

Arches.—*Arched Ceilings With Iron Beams.*—A mathematical consideration of the strains on arches between I beams.—Brick and iron arches are both dealt with, and the cost of the latter given. *Ingenieur und Architekten Vereines*, April 18, 1885, pp 151 to 154.

Brake.—*Brauer's Dynamometric Brake.*—Dispenses with the wooden jaws usually employed, an iron band being used for flat, and a wire rope for grooved pulleys. It does not require to be kept cool by water, is simple, and can be used in confined spaces, its oscillations are limited and it gives clear indicator diagrams, but is more costly and requires more care than the ordinary style. A detailed description with illustrations. *Translated from the Bulletin de la Société Industrielle de Mulhouse for the Inst. of Civil Engs.* Vol. lxxx. Session 1884-85 part 2.

Bridge.—Description of an iron railroad lift bridge over the Ourcq Canal on the Belt R. R. of Paris. The surface of the track is .35 metre (1 foot 2 inches) above the water. The bridge is for double track, 9.23 metres (30 feet 3 inches) long, and raised vertically by chains, the gearing for which is supported by two high brick arches, over which are steps for pedestrians. It is operated by hand. Views and detail drawings of bridge and machinery are given. *Le Génie Civil*, May 2, 1885, pp 1, 2, 3.

Bridges and Culverts.—Report on the construction work on the Eyoumtiers and Meymac, Ry., (France). Several pages of figured drawings of the different classes of bridges, culverts, and viaducts are given, with tables of dimensions and cost. The works are for a single track. *Revue Générale des Chemins de Fer.* April, 1885, pp 197 to 206.

Cement.—(See Portland Cement).

Coal.—*Utilization of Coal Cinders.*—A paper on the manufacture of building bricks from cinders. They are passed through a wire-gauze sieve of two gauges, one coarse and one fine; the larger cinders being used again as coke, and the finer for bricks. They are ground up with slaked lime in the proportion of 10 parts cinders to 3 parts lime, and compressed into bricks in a specially designed machine. Notes on the cost and strength are given, and drawings of the moulding machine. *Le Génie Civil.* June, 6, 1885, pp. 84, 85.

Dredge.—*Hydraulic Dredge.*—A detailed description, with plan and sections, of a powerful machine by Bruce and Batho for use in Burmah. Excavates to a depth of 15 feet and raises 250 tons per hour. Twin-screw propellers. Direct acting, differential pumping engine, cylinders 17 inch by 24 inch; capable of maintaining a constant pressure of 1000 pounds per square inch. Excavator 8 feet diameter with three blades. *Engineering*, June, 12, 1885, pp. 643, 649.

Elevated R. R.—(*see* Railroad.)

Lubricants.—*Notes on the Use of Colza and Minera Oils for Lubricating Rolling-Stock.*—An exhaustive paper on the comparative values of raw colza oil and the natural mineral oils from Alsace-Lorraine and the Caucasus; with notes as to the results obtained on different French lines. Several diagrams and tables of results are given with detail drawings of oil boxes. The composition and casting of white metal bearings are also mentioned and a description given of the boxes used. By M. Salomon, engineer of rolling-stock; Eastern Ry. of France. *Revue Générale des Chemin de Fer.* April 1885, pp. 216 to 240.

Mining.—*Exhaustive Mining.*—A paper by W. H. Jennings on the best way of getting out all the coal from mines; pillars being left while working, which are removed when the chambers are worked out. It deals with the Hocking Valley regions, but is applicable to all districts. The writer suggests that more care should be taken in mapping the work done each month, and in comparing the space excavated with the weight of coal returned, for the information of the owner and foreman. *Ohio Mining Journal*, May 15, 1885, pp. 15 to 27.

Portland Cement.—*On Testing Portland Cement.*—A paper on the best way of estimating the strength and value of cements, with remarks on preparing the briquettes and applying the tests. Though usually tested neat, it is in practice mixed with sand, rendering such tests unreliable. Tables and diagrams of results are given. *Engineering*, June 12, 1885, pp. 656, 657.

Railroad.—*Project for an Elevated Electric Railroad.*—The scheme proposes a single row of columns, 50 metres (164 feet) apart, down the middle of the street with lattice girders between, brackets projecting at right angles on either side; on each bracket is a single rail, 10 metres (33 feet) above the surface of the ground. The cars have the wheels overhead and are suspended from the rail. The electricity is conveyed by wires from generating stations. An elevation and section are given. *Le Génie Civil*, May 2, 1885, pp. 11, 12.

Rolling-Stock.—Description of an iron ballast wagon, capable of being used for carrying freight also. It has trap doors for discharging on either side or in the middle of the track; and wooden falling sides like a flat car; it can be emptied while standing or in motion. It is carried on two axles 4.75 metres (15 ft. 6 in.) c. to c. Length 6.05 metres (20 ft.) over all; width 2.42 metres (8 ft.), height from rails 2 metres (6 ft. 6in.) Illustrated. *Le Génie Civil.* June, 6, 1885, pp. 83, 84.

Submarine Work.—*Putting Bolts Through a Retaining Wall under Water.* Describes means employed to put bolts through a concrete wall, with an uneven stone facing, at a distance of 10 feet below the water line. A caisson 4 feet by 3 feet by 11 feet deep was employed, sufficiently large for a man to work the rock drill. The bolt holes were 2¾ inches diam, 6 feet 6 inches long, and were drilled in 40 minutes. *Engineering*, June, 12, 1885, p. 647.

Market Report of Engineering Materials.

New York, June 25, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles		1.9c. @	2.2c.
Tee		2.2 @	2.25c.
Beams and channels		3.0c. @	
Tank		1.9c. @	2. 0c
Shell		2½c. @	2¾c
Steel plates, Tank		2¾c. @	3c.
WROUGHT-IRON PIPE.. PITTSBURGH.			
Butt welded, black	Discount	45 @	50
" galvanized	"	35 @	40
Lap welded black	"	65c. @	
" Galvanized	"	45 @	50
Boiler tubes	"	60	
RAILS.			
Steel (large lots at mill)		$27.00 @	27.50
Old rails		16.50 @	17.00
Old rail steel		16.50 @	17.00
R. R. spikes		1.8 @	1.9c
R. R. splice-plates		1.65c. @	1.75c.
R. R. Track Bolts		2.6c. @	3c.
Barb-wire fencing, galvanized		4½c. @	5½c.
" painted		3½c. @	4½c.
Corrugated iron			
Nails			
Iron		2.25	
Steel		2.25	

METALS.

COPPER.			
Lake Superior		11.35 @	11.40
Other Brands		10¾ @	11⅛
LEAD.			
Com. Domestic		3.65 @	3.70
Lead Pipe		.06¾	
Tin-Lined Lead Pipe		.15	
Sheet Lead		.06¾	
ZINC.			
Sheet		0.05 @	0.05½

BRICK.

(Cargoes afloat)			
Haverstraw	per M.	$6.25 @	6.50
Fishkill		4.75 @	5.50
Up-River		5.70 @	6.00
Jerseys		5.50 @	5.75
Long Island			
" pale			
FRONTS.			
Croton red		13.00 @	14.00
" dark		13.00 @	14.00
" brown		12.00 @	13.00
Philadelphia pressed		24.00 @	25.00
Trenton "		24.00 @	25.00
Baltimore "		37.00 @	41.00
Buff "		33.00 @	35.00
Enameled English		65.00 @	130.00
" American		85.00 @	120.00
Fire brick		25.00 @	40.00

CEMENT.

PORTLAND.			
Gibb's	English 400 lbs. per bbl	2.75 @	2.90
K. B. & S.	" "	2.85 @	3.00
Burham	" "	2.70 @	2.85
Keene's fine	" "	9.50 @	10.00
" course	" "	5.00 @	6.00
Roman		2.75 @	3.50
Largerdorfer	German "	2.55 @	2.80
Dyckerhoff,	" "	2.90 @	3.25
Stettiner	" "	2.60 @	2.65
Hanover	" "	2.60 @	2.65
Vorwohler, Lion	"	2.90 @	3.25
Alsen,	" "	2.55 @	2.60
Fieve	" "	2.40 @	2.50
Saylor's American		2.15 @	2.40
Windsor	U. S. C. Co.	1.00 @	1.1
Standard	U. S. C. Co.		1.15
Cable's Portland	U. S. C. Co.	2.15 @	2.40
ROSENDALE cements		1.00 @	1.10

LIME.

Rockland common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	0.95	
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1	per cub. ft.	0.90 @	95
" " No. 2	"	0.75 @	0.80
" " light drab	"	0.80 @	0.95
Berlin " in rough	"	0.75 @	1.00
Berea " "	"	0.75 @	1.00
Brownstone, Portland, Ct.	"	1.00 @	1.30
" Belleville, N. J.	"	0.75 @	1.25
Granite, rough		0.60 @	1.25
Common building stone per load		2.00 @	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.		0.40 @	3.00

SLATE.

Purple roofing	per square	6.00 @	7.00
Green	"	6.00 @	7.00
Red	"	15.00	
Black Penna. (at New York)	"	4.50 @	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box	per M.	16.00 @	20.0
Choice	"	55.00 @	80.
Tally plank, 1¼ in. 10 in. dres'd,	each.	.44 @	.5
Tally boards, dressed com.	"	.28 @	.30
SPRUCE, Boards dressed	"	.25 @	.28
Plank, 1¼ in	"	.28 @	.30
" 2 in.	"	.38 @	.40
" 2 in. dressed	"	.43 @	.45
Timber	per M.	20.00 @	22.00
HEMLOCK, Boards	each.	.18 @	.20
Joist, 2½ × 4 to 4 × in		.17 @	.44
OAK	per M.	55.00 @	65.00
CYPRESS 1, 1¼, 2 and 2¼ in	"	35.00 @	40.00
YELLOW PINE, Girders	"	26.00 @	35.00
Dressed flooring	"	30.00 @	40.00
SHINGLES, Extra shaved pine, 16in.	"		
" sawed 18 in.	"	5.75 @	6.00
LATH, Cargo rate	"	2.40 @	2.50

PAINT.

Lead, white, American dry	per lb	.04¾ @ .05
" in oil pure	"	.05¼ @ .05¾
English, B. B. in oil		.08½ @ .08¾
Red, American		.05½ @ .05½
Litharge	"	.05 @ .05¼
Venetian red, American	"	.01 @ .01¼
Indian red	"	.05 @ .10
Vermillion, American lead	"	.11 @ .11½
Paris green	"	.15 @ .19
Umber, Amer. raw and powdered	per lb.	.01¼ @ .01½
Drop black, Amer.		.08 @ .12
" "		.09 @ .11½
Chrome green		.05 @ .15
Oxide zinc, American		.03¼ @ .04
" French		.06¼ @ .06½

Car Wheel Flanges.—At the convention of American Railway Master Mechanics held in Washington, D. C., it was the almost unanimous opinion of the delegates that flanges generally were made too deep. The questions as to the proper size of wheel centers and the correct width and thickness of tires were referred to a committee, to be reported upon at the next convention. Jacob Johann, of the Wabash and St. Louis Railroad, read the report of the committee on "Improvement in the Construction of Boilers.